HIGHWAYS

UNDER THE EDITORIAL SPONSORSHIP OF

THE BUREAU OF URBAN RESEARCH

PRINCETON UNIVERSITY

HIGHWAYS

IN OUR NATIONAL LIFE

A SYMPOSIUM

EDITED BY JEAN LABATUT

AND WHEATON J. LANE

PRINCETON, NEW JERSEY

PRINCETON UNIVERSITY PRESS

1950

LONDON: GEOFFREY CUMBERLEGE, OXFORD UNIVERSITY PRESS

PRINTED IN THE UNITED STATES OF AMERICA BY

THE VAN REES PRESS, NEW YORK

Introduction

TWENTY-FIVE years ago Hilaire Belloc, the distinguished historian, wrote in an essay entitled *The Road,* "Not only is the Road one of the great human institutions because it is fundamental to social existence, but also because its varied effect appears in every department of the State. It is the Road which determines the sites of many cities and the growth and nourishment of all. It is the Road which controls the development of strategics and fixes the sites of battles. It is the Road which gives its frame-work to all economic development. It is the Road which is the channel of all trade and, what is more important, of all ideas. In its most humble function it is a necessary guide without which progress from place to place would be a ceaseless experiment; it is a sustenance without which organized society would be impossible; thus, and with those other characters I have mentioned, the Road moves and controls all history." [1]

Today Americans are conscious of the importance of roads as never before. During the recent war everyone necessarily recognized the role that roads played in the grand strategy of the conflict; and the Burma Road, the Libyan Road, and the Alcan Highway became expressions as commonly used and as familiar as, say, the Lincoln Highway had been before. Both here and abroad motor transport played an all-important part in the winning of the war, whether in the logistics of supply or in the invasion of a continent. Since then, the domestic scene has caught and demanded our attention. Whereas in 1921 American motor vehicles traveled some 55 billion miles on 387,000 miles of surfaced roads, today they are traveling about 368 billion miles over 1,500,000 miles of surfaced roads; the result is a congestion that affects, or disaffects, almost everyone. Motorists have become aware of the limitations of highways built only a decade or two ago, and are generally interested in the problems of planning, design, and engineering. Parkways, scenic routes, and roads to our neighboring countries have greatly stimulated pleasure driving for tourists. Freight traffic has increasingly turned to the highway from the railroad, even for long hauls; and of the total tonnage of the nation's freight, the percentage

[1] See the introduction in Hilaire Belloc, *The Road* (London, 1924; and New York, n.d.).

hauled in trucks is constantly growing. Today there are few products, agricultural or industrial, which are not carried one or more times over the road. It is a truism that the motor vehicle, which ignores local boundaries, has become the most influential nationalizing force in American society.

This symposium, *Highways in Our National Life,* has been projected by The Bureau of Urban Research of Princeton University as a means of presenting the viewpoints of specialists in both the historical and analytical aspects of the highway. The multiple factors to be considered in the problem of highways, as seen from the broad point of view of our national life, obviously required the attention of not several but many scholars, historians, sociologists, economists, engineers, landscape architects, and city planners. The forty-five essays in this book have thus been written by contributors each writing with complete familiarity in his particular field.

Even so, complete coverage of topics relating to highways has not been obtained. The most obvious omission is that pertaining to military aspects. This gap has arisen from the inability of the editors to find authors both competent and willing to discuss them. Thus the reader will find no mention of Vauban or Haussmann, no account of Hitler's autobahnen, nor any discussion of the role of American highways in national defense, interesting as that last topic would have been for inclusion.

Although many of the contributors have examined the essays of others, as befits the nature of a symposium, the reader will find on occasion some slight overlapping within each general section. This is, in the editors' opinion, not only inevitable but desirable, since each essay is considered as a whole and can be read without reference to others.

The first nine of the forty-five essays comprising this symposium are historical in nature. Because the Road, as has been remarked, is one of the fundamental institutions of mankind, dating back before recorded history, the first essay is written, appropriately, from the anthropological point of view. Professor John O. Brew briefly but ably analyzes the interactions of the Road and the culture of primitive man, and traces the development of travel and trade in the prehistoric era. The appearance of roads and their development, with the rise of civilization in the Near East, are treated by the late Dr. Ernst Herzfeld; while the ancient trading routes, often used for other purposes, leading to the Far East, are discussed with scholarly authority by Professor L. Carrington Goodrich. The far-flung highway system of the Roman Empire receives its just due from the skillful pen of the Rev. Dr. Martin P. Charlesworth;

while a survey of English roads, which derive from the Roman system and reveal the relative permanence of a right of way, is presented by Sir Alker Tripp, C.B.E.

Turning to the New World, the reader will find the Indians and their trails and travel discussed in a scholarly but most readable paper by Dr. Herbert J. Spinden. The three periods in which the history of the American highway is naturally divided—the period before the coming of the railroad in which both Indian and English influence are evident, the second in which the railroad overshadows the highway, and the modern period of the automobile—these are handled by Wheaton J. Lane, co-editor; by Mr. Albert C. Rose of the Bureau of Public Roads (formerly the Public Roads Administration); and by Mr. Spencer Miller, Jr., New Jersey State Highway Commissioner. The approach in these three essays is largely factual yet, it is hoped, with enough interpretation to give the reader clear insight as to why the American highway system developed as it did.

The analytical section of the symposium, comprising thirty-six essays, deals with the functions and forms of the highway today. Grouping in this section follows the five general headings of social aspects, economic problems, legal aspects, physical problems or what might be called the technique and art of the highway, and highway operation.

In this first group, Professor Carle C. Zimmerman looks at the highway from the broad point of view of the sociologist, showing how three types of road system, the footpath, the post road, and the advanced highway, are closely related to different types of culture. Professor Francis E. Merrill points out how the greatly increased mobility of the population, arising from the use of the automobile, has created various social problems. The influence of the highway on urban and suburban development is discussed by Mr. Joseph Barnett of the Bureau of Public Roads, while a similar study relating to rural areas is presented by Professors Walter Firey, Charles P. Loomis, and J. Allan Beegle. Border highways and the social aspects of our relationship to Canada and Mexico are treated by two citizens of those countries, Mr. Alvan S. Mathers and Mr. Carlos Contreras, respectively; while the Pan American Highway, in its non-military aspects, is discussed by Mr. J. L. Harrison of the Bureau of Public Roads.

In the second group, the economic, Professor Shorey Peterson examines some of the fundamental economic problems of the highway, pointing out the existence of opposed conceptions of its function. Professor Homer Hoyt, urban real estate consultant, indicates the influence of highways and transportation on the structure and

growth of cities, showing how the creation of different kinds of transportation facilities have affected urban development. Mr. Sigvald Johannesson, formerly of the New Jersey State Highway Department, discusses the thorny problems of highway finance; while Mr. George Romney, of the Nash-Kelvinator Corporation, reveals, with frequent historical allusions, the interaction of the motor vehicle and the highway. The relation, both complementary and competitive, of the railroad to the highway is presented by Mr. Julius H. Parmelee and Mr. Earl R. Feldman of the Association of American Railroads, who point out the disadvantages the railroads suffer in competition with highway transportation. Mr. John C. Cooper, of the Institute for Advanced Study, examines the same kind of relationships between "highways of the earth and in the air." Mr. William A. Bresnahan, of the American Trucking Associations, Inc., relates the amazing growth of freight transport over the highway; while Mr. Leslie Williams, consultant in city planning and traffic engineering, discusses the development of mass transit over the highway, points out the present day trends, and suggests those of the future.

The third group, pertaining to the legal aspects of the highway, includes two essays by Mr. David R. Levin of the Bureau of Public Roads, one dealing with the control of access and of the use of land adjacent to roads, the other with the permanence of the right of way in a changing environment. In a third essay, Mr. Charles Ross, legal historian, comments interestingly on the constitutional powers divided between the states and the Federal government.

The fourth section, on the technique and art of the highway, comprises nine essays principally concerned with physical problems. Mr. G. Donald Kennedy of the Automotive Safety Foundation discusses highway planning, relating its development and showing the role that traffic and financial surveys play in formulating highway programs. The design of modern motorways is treated in detail by Mr. Gilmore D. Clarke, consulting engineer; while that of highway intersections is written by Mr. R. H. Baldock, Oregon State Highway Engineer. Mr. H. J. Neale of the Virginia Department of Highways treats of the esthetics of the highway in his account of parkways; while Mr. L. I. Hewes of the Bureau of Public Roads presents the general subject of highway engineering. Mr. Harry C. Coons of the Michigan State Highway Department discusses foundations and surfaces in his essay on construction techniques. The ever-present problem of maintenance operations is handled by Mr. Samuel O. Linzell and Mr. Harry D. Metcalf of the Ohio Department of Highways. Mr. Samuel G. Hibben of Westinghouse Electric

Corporation discusses the problems of highway lighting and visibility; while Professor Hans F. Winterkorn presents much interesting information concerning the influence of climate on the highway.

The final section includes nine essays on the general subject of highway operation. Mr. Richard O. Bennett of the National Safety Council comments in detail on highway safety in respect to the pedestrian, the cyclist, and the horse-drawn vehicle; while Mr. Norman Damon of the Automotive Safety Foundation does the same for the motor vehicle. Mr. D. Grant Mickle, also of the Automotive Safety Foundation, discusses traffic operations; while Franklin M. Kreml, director of the Northwestern University Traffic Institute, handles the subject of police traffic control. The ever-present and growing problem of parking is discussed by Mr. Charles S. LeCraw, Jr., of the Eno Foundation for Highway Traffic Control. The multitude of services provided along the modern motorway, with some account of their historical development, are treated by Mr. Orin L. Kipp of the Minnesota State Highway Department. The subjects of motor vehicle legislation and administration, which necessarily overlap in part, are handled respectively by Mr. J. Allen Davis, general counsel of the Automobile Club of Southern California, and by Mr. Basil R. Creighton of the American Association of Motor Vehicle Administrators. And finally the adjudication of traffic violations and the development of traffic courts are discussed by James P. Economos, director of the Traffic Court Judges and Prosecutors Conference of the American Bar Association.

In conclusion Jean Labatut, co-editor, presents a summation of the symposium, giving a synthesis of the problems of the highway as they relate to the concept of the future planning of the highway structure in the United States.

Acknowledgment

THE editors wish to express their profound gratitude to the forty-eight contributors who have so liberally given of their knowledge and time to this symposium. They have most generously allocated whatever royalties might accrue to the research activities of The Bureau of Urban Research of Princeton University.

Grants toward editorial assistance were received from the Spears Research Fund and the University Research Fund, for which we are grateful.

Among the readers of the essays who made invaluable suggestions, mention must be made of Dr. Cyril E. Black of Princeton University, Professor Kingsley Davis of Columbia University, Professor Edward S. Corwin, Professor Kenneth J. Curran, Professor Philip K. Hitti, Professor Philip Kissam, all of Princeton University, Commander Charles M. Noble of the New Jersey State Highway Department, Mr. M. Halsey Thomas of the Columbia University Library, Dr. Louis C. West of Princeton University, and Dr. Donald N. Wilber of Princeton University. To them we extend our heartiest thanks.

To Miss Dorothy E. Whiteman, executive secretary of The Bureau of Urban Research, the editors wish to express their sincere appreciation for her intelligent and efficient efforts in the direction and compilation of the symposium and for the many excellent ideas advanced. Miss Ruth Caplan did yeoman work in the handling of the manuscripts. We also wish to thank those, including members of the Executive, University, and Advisory Committees of The Bureau, who made suggestions as to possible contributors.

To Mr. Datus C. Smith, Jr., director of the Princeton University Press, and to Mr. P. J. Conkwright, who designed the format of the book, we are also most grateful for constructive comments and ideas.

JEAN LABATUT

WHEATON J. LANE

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HISTORICAL

1 THE HIGHWAY AND THE ANTHROPOLOGIST

BY JOHN O. BREW

THE *Way* has ever been an important tool in the building of cultures. At times it is even all-important in the fashioning of some small or large cultural highlight, some local development which for a moment marks a peak in man's progress, upon which the eyes of the surrounding country are focused. The means are many by which man's transport problems have been solved. There are waterways: inland, on lakes and rivers; coastal, along the shore; on inland passages of the sea behind the outer shore, as along our south Atlantic coast and along the north Pacific coast from Seattle to Alaska; and across the open seas. There are landways: primitive trails, for runners and porters; pack trails, for beasts of burden; and highways, for wheeled vehicles. The landways are of many kinds: roads following natural contours and roads artificially graded; roads utilizing natural surfaces and those with fabricated surfaces; roads on sand and on gravel; roads over wet terrain and over dry; flat roads and mountainy roads; roads over swamp and bog and roads over watercourses. And now, in addition to the waterways and landways, we have the airways, with a carrier which disdains most of the difficulties besetting other vehicles. The invention of the airplane bids fair to surpass even the inventions of wheel and sail in its effect upon man's culture.

All these pose different problems, utilize different vehicles. Throughout there is an intimate relationship among physiography, technology, and general cultural pattern which provides an intriguing study for the anthropologist. This essay will indicate and explore briefly many of the facets of that study. Primary consideration will be given only to landways; waterways will have their day in court only when they meet the landways, meetings which are of great importance to both. All forms of landways will be treated, from the winding path to the trunk highway. In general discussions of topography and material, of function and significance, they will all be grouped under the collective term, the Road.

The anthropologist must consider man's routes from two basically different points of view. To begin with, the routes, for the most part laid out by man, and the manner in which they are laid out, the media utilized, and the vehicles used thereon, are all determined to a greater or less extent by the culture of the particular men involved.

Thus, in a very real sense, the Road itself is conditioned by culture.

In the second instance, the point of view must be reversed and the anthropologist must consider the effects of the Road upon the culture or cultures which it serves. These effects are various: in their manifestations they may be classified as material, historical, sociological, and psychological.

From the first point of view it is perhaps necessary to consider for a moment the possible exceptions, that is, trails used but not made by man. At the very beginning of human travel one can postulate the use by man of animal paths, and this has been done. Theoretical pictures have been presented of Paleolithic man slinking along the pathways of the mammoth and woolly rhinoceros; of tropical man traversing the jungles on paths, eight feet wide and twelve feet high, made by elephants. The extent and significance of this phenomenon can hardly be weighed. There is no doubt that it played its part. The writer once took a pack train out of a Colorado River canyon over a trail made by sheep between their grazing lands on the plateau and the water below. The American Indian certainly used trails made by buffalo and elk.

In general, however, man makes his trails and roads. At first he did this in the same manner as other animals, by use, detouring where possible around difficult obstacles. His tendency was to follow the lines of least resistance in topography, and he converged upon gaps in the hills and mountains and upon the river valleys. Even without boats he made the rivers the main arteries of traffic. His major settlements were much more often than not along the banks of rivers and the largest of them were usually to be found where two rivers joined. It is often stated that 80 per cent of the prehistoric settlements in the eastern United States, east of the Rocky Mountains, were on 2 per cent of the land—along the river banks. Important settlements away from the rivers will be found mostly where roads meet and cross. So, as human cultures developed, the locations of important communities of men, the towns and the cities, were largely determined by the roads, of one kind and another. Furthermore, these locations once established, the expansion and development of the towns and of the cultures of which they were a part were also determined by the Road. Over the Road passed trade which brought food to the towns and, particularly after the "Neolithic Revolution," new materials. The Road then distributed the products, fashioned from those materials by the artisans in the towns, from town to town and out into the countryside.

But other things besides goods were involved in trade. The diffusion of ideas as well as food and raw or fabricated articles was a

function of the Road. Social and political systems, philosophies and religions, sorcery, alchemy and scientific knowledge all were passed from man to man, from place to place, along the Road. Impulses for change were ever coursing up and down its length.

Culture knows no *status quo;* those conservatives who desire it pursue an illusion which is, in fact, a cultural paradox. The concept exists in almost all cultures, yet the realization is impossible in any. The very nature of human culture precludes its establishment. The Road is perhaps its greatest enemy. Hence, one of the first acts of its exponents during the intermittent periods when they rise to full power is to close the Road, and we have *forbidden cities, iron curtains,* and other devices to block the flow of new ideas and revolution. Historical evidence clearly demonstrates that the closing of the Road can do no more than retard the rate of change. Yet so obvious is the threat of the Road to the *status quo* that the high priests of the cult are forever trying to choke it off.

And this leads us to a conclusion of great importance in our time. Namely, the Road is an instrument of democracy and the foe of differences and misunderstandings. Intense nationalisms and sectional rivalries eventually fall under the pressure of the machines and the ideas which course along the Road. The freemasonry of the traveling merchant is proverbial in all cultures and is a function of this attribute of the Road. In times of war, at the height of the intense feeling engendered, we are outraged by evidence which always comes to light of the continuation of trade across the lines of conflict. In modern warfare, in particular, we channel our own ideas, our propaganda, by means of whatever openings we can find through, under, or over these lines. All of this bears witness to the power of the Road to service basic human needs for goods and knowledge.

The exact details of the beginnings of the Road are lost forever in the mists of Paleolithic antiquity, but the general outline can be traced with reasonable assurance. The importance of animal trails is variously assessed by different writers. We may be certain, however, of the fact that Early Man utilized such trails, at least in pursuit of the animals who made them. The expansion of man's regular routes beyond the confines of his primitive ecological unit—over and above, that is, the trails established to the waterholes, from cave to cave in the local scene, etc—in all probability had to do with the materials needed for tools and ornaments. The archaeologist finds his earliest evidence of trade and transport in flint and shell. Grand-Pressigny flint and shells from the Atlantic and the Mediterranean were carried along the trails of Paleolithic Europe.

Man's legs provided the motive power for this transport and the loads were borne by arm and back and on the head.

The "Neolithic Revolution" gave man control over plants, and the guaranteed food supply achieved by this new power permitted the growth of towns, more leisure for industrial experimentation, and the development of specialized artisans who, relieved of the necessity of collecting their own food, could devote their time and energy to the making of pots or the grinding and polishing of superior stone tools. At about the same time another new power of vast importance came under man's control. The domestication of animals rivals the domestication of plants for first honors as the distinguishing mark of the New Stone Age. The newly tamed animals added further security to the food supply. They also permitted expansion of transport, and at a time when it was sorely needed; they served to bring the produce of the fields to the town and to carry the special products of the craftsmen to the farmer's hut, to the herder's tent, and to towns where other things were made.

With a supply of draught animals, vehicles became practical. Few anthropologists will quarrel with the hypothesis that before Neolithic times rudimentary vehicles had probably appeared, sledges or travois pulled by men or dogs. Effective development of the vehicle to raise the level of transportation came, however, with the introduction of the ox between the poles.

The next step, which V. Gordon Childe describes as "the crowning achievement of prehistoric carpentry," was the invention of the wheel. This and the domestication of the horse increased both the range and speed of transport. And with the horse, man found an animal practical for riding as well as carting.

The expansion of trade during Neolithic times is a matter of archaeological record in many parts of the world. Shell trade increased tremendously. The more highly tooled stone implements demanded better grades of stone than did the Paleolithic fist axes and crude spear points, which often could be knocked out of stones picked up in local stream-beds and outcrops. Furthermore, urban life speeded social and religious developments and thereby created increased demands for ornaments and objects whose intrinsic and imputed properties could satisfy the new and expanded functions of the sorcerers and magicians. Traders roamed afar in search of magic substances, chunks of metal, fancy stones, unknown shells and feathers which they could give to the farmer to ensure the fertility of his fields, receiving in exchange some of the produce of those same fields.

The extent of Neolithic trade is well illustrated by the finds in

pre-dynastic Egyptian graves which include lapis lazuli in all probability from the Iranian Plateau, resin from the forests of Syria or farther south on the Arabian peninsula, malachite from Sinai or the eastern Nubian desert, and obsidian from the Aegean region, Arabia, Armenia, or even Abyssinia. And the record, of which this is a mere indicator, can be duplicated wherever farming had become the order of the day.

The invention of the wheel brought a change, also, in the Road itself. The concentration of the entire weight of the load at the tangent of the Road with the wheel meant that full advantages of the wheel could be achieved only with a surfaced road. The anthropologist, however, finally becomes inured to the repeated discovery that a phenomenon which arises in one part of the world from a specific cause can appear elsewhere from an entirely different cause. So he is not particularly surprised when he discovers paved roads in the New World although there were neither draught animals nor wheels to use them. The Inca rulers had a system of stone-paved roads running from one end of their empire to the other in the Andes of South America, with crossroads at intervals from the highlands down to the cities on the Pacific coastal plain. Over these roads there operated a service of fleet-footed couriers and mobile shock troops by means of whom the unusually highly developed and centralized political power of the Incas was maintained and the products of the widely varying climatic zones of the empire, with a range in altitude approaching 20,000 feet, were exchanged. The Maya on the Yucatan peninsula in Mexico also made paved roads although they too had no wheels and no beasts of burden. Although Yucatan is a land of tropical forest, its peculiar geological structure permits no rivers, at least above ground. So land transport is the only feasible type and the Maya connected their extensive temple centers by means of stone-surfaced boulevards.

The paving of the Road, for the most part, is correlated with the metal ages rather than with the Neolithic. Bronze Age man gained a new power from the addition of tempered metal to his kit of tools and weapons. With metallurgy came another necessary stepping-up of the level of the transport industry; for copper and tin, the major components of bronze, occur but rarely in the earth's surface, and seldom together. Either or both had to be imported by most of the prehistoric centers where bronze was made. Bronze, however, was expensive and the full effect of the invention of metallurgy was not realized until the Iron Age brought cheap metal.

Furthermore, metal tools greatly increased industrial specializa-

tion, withdrew more men from farming and herding, increased the size of individual farms, permitted many new crafts in the cities and towns, and thereby increased tremendously the need for transportation. So the Road and its vehicles again improved. And this process has continued with each industrial revolution down to the present day so that when in 1948, for example, the Russians closed the highways and railroads to Berlin, the English and Americans could immediately make plans to transport food and supplies for 20,000 of personnel and dependents and for an entire section of the native city, by *air*.

There can be no doubt, as Hilaire Belloc points out in his excellent little book, *The Road,* that, although we take it for granted, the Road is one of the fundamental institutions of mankind—determining the sites of cities, influencing their growth and nourishment, fixing the locales of great battles, and providing the major channel of trade and of ideas.

In the course of developing the Road man has learned many things, and these, too, are pointed out by Belloc, in the clearest, most concise statement I have as yet encountered of the many problems involved. The primitive builders of the Road learned that they must go around a marsh, yet they learned to cross watercourses. They learned that the going was easier over one kind of soil than over another, over one kind of surface in summer and another in winter, over one kind in wet weather and another in dry, over one kind with heavy loads and another when traveling light and, eventually, over one kind with a pack train and another with a cart.

These principles, for the most part empirically established, and the nature and location of available road material, determine the nature and location of the Road.

The use of the Road is another matter, conditioned much less by mechanical factors or by physiography and much more by the culture of those who made it and those it serves. This use may be for evil or for good—during most periods in the life of the Road, no doubt, a bit of both. Yet occasionally the influence of the Road as expressed by its use becomes all-powerful in one direction or the other. In times of famine the Road may be the life-line of the culture, in times of war it may be an instrument of death. At other times, with no crisis apparent, it may spread the slow poisons of cultural decay which have undermined so many civilizations and empires of the past, or it may transport the hope and benefit of a great forward step in human progress, new inventions or ideas, bringing a better and more satisfying way of life to the men and cities along its route.

The archaeologist and the historical anthropologist trace these influences, on one side or the other of the scale of human values, back along the Road, in reverse, charting their course, estimating their speed, and recording their results as well as the evidence will permit. The social anthropologist, with his field in the present, and his eye to the future, takes these results, gauges by them comparable phenomena he sees in action around him, and attempts either to predict the development of the culture he is studying or, if confident of his own moral concepts and judgment, to suggest means whereby that development may be guided toward the greater good. And whichever way the development goes, toward progress or decline, it will march, in large measure, along the Road.

2 THE HIGHWAY SYSTEM IN THE NEAR EAST FROM 2000 B.C. TO 500 B.C.

BY ERNST HERZFELD

"In the desert clear the way for YHWH,
make straight a high road for your God in the 'Arābhāh
Every valley shall be raised
and every mountain and hill made low;
the crooked shall become straight
and the *rᵉkhāsīm* a plain!" [1]

The "desert" is the region from the Se'ir range to the Sinai peninsula, the Wadi 'Arābāh is a tract east of the Jordan. These verses of Isaiah (XL:3-5) refer to the building of a high road from Babylon to Egypt by Cyrus, after his conquest of Babylon in 539 B.C.

At the same time, the prophet Zoroaster says in one of his odes, Yasht 53,5: "I who want to call forth Thy most-high Srōsho at the stage, when arriving at the eternal hostelry of Vahumano, on the straight road on which Ahuramazdah is dwelling." He uses the highroad as a metaphor for life as a journey to heaven; Vahumano "Goodwill" is one of the aspects of his god; Srōsho is the sentry at the stage in heaven; one must call him to open the gate, for the horses are kept in the closed yard of the stage.

Over a hundred years later, Ctesias, physician-in-ordinary to the king Artaxerxes II and the queen Parysatis (quoted in Diodorus 2, 1, 5,) describes the Persian highroads with almost the same words as Isaiah: "Semiramis built a highway from Babylon to Agbatana (Hamadan), levelling the eminences and filling the depressions, in order to leave an immortal monument, and it is called to the present time 'Semiramis' road." This road crossed the Tigris at Opis, later Ctesiphon, below the mouth of the Diyala. The name refers to a point of that road at the foot of the rock of Behistun, with the great monument and inscription of Darius, 520 B.C. Ctesias attributed it to the Assyrian queen on account of its name. The first Muslim conquerors of the seventh century A.D. called the rock which rises straight 3,000 feet above the plain "Sinn Sumaira, tooth of Sumaira," after an Arab lady in the entourage of the prophet Muhammed, who had a protruding tooth. The king Sargon II of

[1] cf. Sidney Smith, *Isaiah xl-lv,* Schweich Lectures, Brit. Academy, 1940.

Assyria, in 713 B.C., calls the mountain "Simirria, a finger-tip mountain which rises like the point of a lance, its head high above the other mountains, dwelling place of the Lady of the gods, the head of which supports the heaven, the root of which reaches the center of the netherworld." It was a cult place of the indigenous goddess Simalia, and Semiramis and Sumaira reflect the old name in Greek and Arabic.

Ancient Assyrian and Persian Roads

East of that point this main road of western Asia, from Babylon to Agbatana, begins climbing up to the high plateau of Hamadan and continues to Ragā-Teheran and Tōsa-Mashhad. Between 539 and 529 B.C. Zoroaster drove over this road, in a carriage with a two-horse team, from his home town Ragā, by Damghan, to Tōsa, taking refuge there at the court of the satrap Hystaspes, father of Darius. From Tōsa the road went down into the plains of modern Russian Turkistan. The easternmost points, at the time when Alexander conquered the Persian empire, were the towns Cyreschata and Alexandria eschate, "the uttermost Alexandria," to be sought in

Ferghana, at the sources of the SyrDarya-Jaxartes. Little over two hundred years later the first Chinese caravans went west over these passes into Turkistan.

It was only one in a system of highways. The Greeks knew another branch better: when they speak of the "Royal Road" they have the highway in mind which connected Ionia with the center of the empire, Susa, not far from the Persian Gulf. Herodotus (5,52f) has preserved a detailed description, after the map of Hecataeus, made between 515 and 500 B.C. and engraved on a bronze plate, which Aristagoras of Miletus showed to Cleomenes of Sparta in 499, when trying to win him over for the Ionian revolt against Darius.

All along this "Royal Road" were relay stations and hostelries, fit for defense and garrisoned, often placed at river crossings and mountain passes; at the provincial frontiers there were toll-bars, "gates." A royal post rode over all these roads, with lead-horses carrying the mailbags, very much as in the early days of the American West. Besides there were signal posts, with towers, from which news was transmitted by fires and mirrors from the ends of the empire to the center, in the shortest time, as described by Pseudo-Aristotle in *De Mundo.*

The entire length of the Sardis-Susa road—and so all others—was measured and provided with milestones "parasangs," a distance of about an hour or little less than 3½ miles. The 450 parasangs or about 1,500 miles from Sardis to Susa were covered in 90 days. The road went from Sardis, capital of Phrygia, to the Halys crossing east of Ankara, in 20 stations, 94½ par., from there in 28 stations, 104 par., through Cappadocia. A short section of 3 stations, 15½ par., through the high mountains of the northeast point of Cilicia led to the Euphrates ford—near modern Izoghlu—in Melitene, then 15 stations, 56½ par., through southern Armenia to the Tigris crossing at Saphe, modern Sufan Dere north of Nineveh, 34 stations, 137 par., went through the East Tigris region, the oil region of Kirkuk and Kufri, to the crossing of the Diyala, which empties into the Tigris between Baghdad and Opis. From there the road passed along the Luristan mountains in the East, by Mandali, old Arderikka, another oil region, and entered the Luristan hills for the last 11 stations, 42½ par., to reach Susa.

This old road made a wide detour to the north, because it followed originally the line leading to the pre-Iranian capital of Asia Minor, Boghazkoi. It took some time before the changed conditions of the period enforced a shorter connection between the actual centers of life and administration. About 400 B.C., Xenophon

marched from Sardis, the residence of Cyrus the Younger, straight to the "Cilician Gates," modern Gülek Boghaz in the high Taurus range, then through the low-lying plains at the Gulf of Issus, over the Amanus passes behind modern Alexandrette to northernmost Syria, the Euphrates east of Aleppo, crossing the river at Thapsacus opposite modern Raqqa, down to the "Babylonian Gates," today "Narrows of Hīt," through Babylonia to the battlefield of Kunaxa, near modern Fallūja, entrance of the Babylonian alluvium. After the battle, the Ten Thousand went to Sitake on the Tigris, and back to Opis on the eastern bank. At the beginning of our era this road and its continuation through Iran to the confines of India, at the Bolan Pass, was described by Isidorus of Charax, a town near modern Muhammira (Abbadan) for Caius Caesar, for whom Augustus planned an imitation of the conquests of Alexander the Great.

In Alexander's time, the road "for wheeled traffic" continued from Susa to Persepolis in Fars, through the "Persian Gates"—a toll-station, the wall of which is still visible north of Tulaspīd in Fahliyūn. From sea-level this road climbed up to 6,000 feet. Apollodorus of Artemita (modern Daskara on the Diyala, east of Baghdad) an author of the Hellenistic period, describes also the straight connection between Babylon and Susa, which crossed the Tigris at Sitake, modern Aziziyya, and joined the Sardis-Susa highway for the last 42½ parasangs from old Dēr, modern Bedrai, to Susa. That the road went beyond Persepolis to Pasargadae, the residence of Cyrus built in 559-550 B.C., is proved by remarkable rock-cuttings, a few miles before reaching Pasargadae. From there the continuation to the north, to Isfahan and Teheran is easy.

The Old Iranian word for these roads is "rathya," whence New Persian rāh, "road," derived from "ratha, chariot." The name "Royal" or "King's Road" was already in use in Assyrian times, and has persisted to the present day. Ammianus, the general and historian of Julianus Apostata, in A.D. 360, describes the "viae regiae" through the provinces Mesopotamia, Assyria, and Babylonia. In Manichaean texts a parable speaks of a "merchant traveling with many treasures on the king's road," and Syriac authors of the fifth century mention "the road of the great-king, which goes [from the Tāq i Girrā pass between Iraq and Iran] to the uttermost confines of the kingdom." A great Arab scholar, al-Asma'i, says of the poet abu-l-Atāhiya—who lived under the successors of Harun al-Rashid—"His verses are like the Highway of the Kings, upon which fall jewels, gold, earth, potsherds and date-stones." Still today it is "Shāh rāh" or "Rāh i Shāh."

An isolated note in an Assyrian glossary of the early first millennium proves, together with the Assyrian expression "King's Road,"

that highroads existed in Assyria and also in western Persia. It is the term "goods-van of Gutium." Gutium was the old name of Media since the middle of the third millennium, and included Hamadan, Kashan, Teheran, Zinjan and the Kurdish regions south of the Urmiya Lake. Heavy wheel traffc would be impossible in that high mountain region without real roadmaking. Since the remote antiquity of the fourth millennium the Kashan region—and so the Zinjan region—were closely connected with the ancient states of Elam and Sumer as the great mining regions, source of copper and other metals. This trade must have led to the organization of transportation during high antiquity.

At the excavations of Assur, a cuneiform document was discovered [2] which has been interpreted as an itinerary or a geographical treatise on the empire of Sargon of Akkad, who ruled in the 26th century B.C.[3] What we have is a fragmentary copy, by a badly trained scribe, of a text which contains two paragraphs of Old Assyrian origin, subjected to a redaction at the time of Sargon II of Assyria just before the end of the eighth century B.C. This redaction gave the fragment an introduction and conclusion which connect it with the legend, not the true history of the old Sargon of Akkad. The original text is thus undated, but intrinsic reasons make it more than probable that it was written about 1800 B.C. Even then, the original text was not a truly historical one.

The first old paragraph gives the length of highways in nine countries, the first of which is lost, but can be restored: [90 bēru (double-hours) of highways in the country Gutium, 20+] 40 in Marhaši, 60 in Tukriš, 90 in Elam, 180 in Akkad, 120 in Subartu, 120 in +Assur (misspelt), 90 in Lullubi, 90 in Anzan." Gutium was already defined as north and western Media, Marhaši is Luristan including the capital Kirmanshah, Tukriš is the region south of Gutium and east of Marhaši, Elam is on the Persian Gulf, Akkad is northern Babylonia, Subartu is Mesopotamia and northern Syria, Assur is known, Lullubi is modern Shahrazur, Anzan is Fars. This is a cosmological concept developed at the beginning of the second millennium, of seven "huršāni, foreign countries" around a center, which for a Babylonian was Akkad, for an Assyrian Assur. In the south the pair Sumer and Akkad may replace the one country, and so here, in an Assyrian document "Assur and Akkad." The "huršāni sibitam" became later, in Iran, the "hafta kršvān," from which again came the Greek concept of the "Seven klimata," which after the Hel-

[2] *Keilinschriften aus Assur verschiedenen Inhalts,* n. 92.

[3] For the literary and geographical problems of this document, see the author's *Zoroaster and his World,* 2 vols., (Princeton, 1947).

AN ANCIENT CARAVAN ROUTE

Where the trail crossed mountain ranges or skirted swamps, it was frequently hewn from the rock, and thus is well preserved today. This section of an old route is in west central Iran.

THE ANCIENT ROAD OF SEMIRAMIS

This scene, in west central Iran, shows a short section of the Road of Semiramis, used through millennia of time. In the background is the base of the great cliff called Behistun, which bears the famous rock-cut relief and inscription of Darius. Since this photograph was taken, an asphalted road has been laid over the trail visible in the foreground.

lenistic period returned to Iran as "Haft Iqlīm." These nine countries are divided, in the text, in three groups. The first four get $90 + 60 + 60 + 90 = 300$ double hours of highways, the second two get $180 + 120 = 300$, the third three $120 + 90 + 90 = 300$, or 3×300, according to their imagined importance. There is no reality at all behind these mythical numbers.

The other paragraph, by far the greater part of the document, enumerates various routes, after the pattern "from place-name A to B, country N." All these routes radiate from Assyria and go either through Mesopotamia to Syria, or through the East-Tigris region to the Persian Gulf, or southeast deep into Iran as represented on the accompanying sketch map. The descriptions fit the conditions of the early second millennium and must be considered as entirely real and historical. They are of high value for our understanding of the communications and trade over the whole Near East at so high an antiquity as about 1800 B.C. But although the document uses the term "rēbitu, highway," literally "broadway," we do not know whether the reference is to tracks, natural roads, or actually products of roadmaking.

3 TRADE ROUTES TO CHINA FROM ANCIENT TIMES TO THE AGE OF EUROPEAN EXPANSION

BY L. CARRINGTON GOODRICH

ANTIQUITY

It can probably be assumed that in earliest times there were at least four main routes or trails leading to and from China across parts of Asia. This assumption is based on indications archeological, historical, agricultural, and linguistic.

1. The northernmost route ran from the Black Sea, between the north flank of T'ien Shan and southern Siberia, across the Gobi, and so into the Ordos region of the Yellow River. We have no knowledge that this route existed until the last few centuries before our era, but it may even then have been very ancient. The people who occupied the Paleolithic and Neolithic sites along the Angara River, north of Irkutsk, found by two Russian explorers in 1938, may have had connections with prehistoric peoples living at the same time in north China and Europe. The earliest indication of trade is the discovery of money of the Bosphorus kingdom dating from about 400 B.C. found north of the western T'ien Shan, near the Ili River. Over this region probably roamed the Scyths, a people whose caps, trousers, boots, belt buckles or clasps, and ability to ride horseback seem to have been adopted by the Chinese of the northwestern states of Chao and Ch'in sometime prior to 300 B.C. Another important weapon, possibly brought over this corridor from west to east, is the long sword. Rostovtzeff has ably argued that it reached China through the agency of a nomadic people known to the Greeks and the Romans as Sarmates.

Among finds of interest dating approximately from this era is one made in 1929 at Pazyryk, in the east Altai Mountains, of ten horses, perfectly preserved in ice, still wearing the accouterment with which they were probably harnessed at the time of the horse sacrifice. While there is no evidence in this find of connections with China, the art motifs are strikingly like those found in southern Russian burials of the same period. Two hundred and twelve tombs, probably of Hsiung-nu chieftains who flourished a little before and a little after the time of Christ, were discovered in 1912 at Noyan-ola (or Noin-ūla), north of Urga, and in 1924-1925 six large and four small ones were excavated. Although these tombs had long since

been plundered—large gold objects, for example, were missing—the objects which remained *in situ* included things of such distinctly Chinese manufacture as silk, lacquer, and jade; there were also articles of Scythian, Iranian, and Greek design. Other tombs of approximately the same period (ca. 100 B.C. to A.D. 100), found recently along this general route, all of which included materials of Chinese make, are the graves at Shibe (or Chibé) and Katanda in the Altai and Oglakty, north of Minusinsk, in southern Siberia. Still farther west, in Crimean tombs of the beginning of our era, silkstuffs and jade hilts fashioned in Chinese style have come to light; also, in a south Russian barrow, a small Chinese bronze mirror, similar in type to another found at Lou-lan in the Tarim basin, and bearing the same inscription. Felt, the initial manufacture of which is credited to the nomads who lived "from the Urals and Caspian to southern Siberia and Mongolia," made its way in early times both to the Chinese on the one side and to the Greeks and Romans on the other. Laufer thinks that the Chinese first began to use it when they altered their battle dress in the time of King Wu-ling of Chao, 325-299 B.C. The ancient metallurgical centers at Minusinsk and elsewhere in this region also may have turned out articles which passed from hand to hand and reached both ends of this route. While the socketed celt and socketed spearhead may have been two such items they appear so early (second millennium B.C.) both in Europe and in China that they must be discarded as evidence. (But see on this point Max Loehr, *Amer. Jour. of Archaeology*, 1949, LIII, 135, who is convinced that the socketed celt of Shang date came to north China via Siberia from Russia.) The pick, however, has a good defense; Salmony, supported by Tallgren, seeks its origin in the Urals. It has likewise been suggested that the huge quantity of gold—some five million ounces—acquired by Wang Mang during his short reign (A.D. 9-23), and found in the palace after his assassination, came in part from Siberia. Certain ornamental themes, such as fighting animals and the flying gallop, may well have developed among the Scyths in the north and spread both into China of the third and second centuries B.C. and into south Russia of the eighth to third centuries B.C. In any case there seems no question that objects both of beauty and of utility were passing back and forth over this route during the last few hundred years of the first millennium before our era.

2 and 3. The next two routes may best be treated as one in antiquity. The northern lies along the southern slope of the T'ien Shan with convenient stopping places at the oases fed by streams from the K'un-lun. The other flanks the southern rim of the Tarim Basin,

and is likewise linked by well known oases. At the eastern end the two routes become one at Tunhuang (in modern Kansu province); at the western they joined either at Yarkand or Kashgar, the starting places for the steep ascent of the Pamirs—a traveler proceeded thence by various roads across Bactria and Iran to the Persian Gulf and the Mediterranean. This great corridor may also have been a very old route. The late Davidson Black thought it possible that this region was the common dispersal center of mankind, but this idea is now questioned. The earliest cultural materials suggesting connections East and West are fragments of polychrome pottery. Discoveries of this type of pottery, dating from chalcolithic times, have been made in north China (especially in the provinces of Honan and Kansu), Manchuria, Jehol, Inner Mongolia, Chinese and Russian Turkestan, Baluchistan, Iran, India, and southwest Russia. But it must be noted at once that the richest deposits seem to occur at both ends of the route, not in the center. In the opinion of Folke Bergman [1] these discoveries do not point to trans-continental trade but to manufacture in different centers by sedentary agriculturists.

Another article frequently found in ancient deposits of the same cultural level is the cowry shell. More than the jars and bowls of painted pottery these shells do suggest trade, for they seem to derive originally from the Maldive Islands. While not found at the western extremity of this route (Arabia, Palestine, and Mesopotamia) they have been picked up in India, southern Russia, the Tarim basin, and north China. These may well have been put to several uses in different parts of the world, as charms and amulets, for example, but in China their main use seems to have been as money.[2]

A third item which suggests long distance trade is jade. The most anciently worked beds may well have been those in Khotan and Yarkand, the deposits in Burma and the Lake Baikal region probably not being touched until comparatively modern times. Jade, which may derive from the Yarkand area, has been found in some quantity in the capital of the Shang Chinese, near Anyang (in modern Honan), which dates it somewhere during the years 1300 to 1050 B.C., and also in other, possibly prehistoric sites between Honan and Kansu. During the next millennium, particularly in the third and

[1] Folke Bergman, *Archaeological Researches in Sinkiang* (Stockholm, 1939), 23-26. Several painted pottery sites, he tells us, have been found in the Turfan basin, but they are relatively scarce, possibly because Sinkiang was merely a transit province, an alternation of fertile oases and stretches of desert, largely too sterile to attract agricultural communities.

[2] Later on they were frequently reproduced in bone and bronze; these too served as coins.

fourth quarters, connections between north China and central Asia developed. Just at the time that Cyrus and Darius and Alexander were active in western Asia, the border state of Ch'in on the northwest frontier of China was busy trying to subdue the Jung and other peoples in Kansu. This marginal region was even then famous as a horse breeding center [3] and undoubtedly had trade contacts with Tarim valley centers. Henri Maspero says that the merchants who reached the end of the trade route (near modern Lanchow) at this early time were Hindus, not Iranians, but does not give a source for this assertion. Whoever they were, they traded both in ideas and in goods.

About 200 B.C. the Hsiung-nu became very powerful, and drove both the Wu-sun and two branches of the Yüeh-chih people out of the western part of Szechuan and Kansu. They migrated westwards, the former settling on the southern slope of the T'ien Shan near Lake Issyk-kul, and the latter—after some stops along the way—north of the Oxus river in the neighborhood of Bukhara. After struggles with the Hsiung-nu lasting some decades, the Chinese decided to find possible allies among the peoples of central Asia and looked for them among their former neighbors.

This policy, initiated in 138 B.C., resulted in active use of the Tarim basin routes, for the first envoy (Chang Ch'ien) made it plain in 126, on his return from Ferghana, Sogdiana, and the Oxus regions, that it was possible to maintain a direct route to these territories. Within a few years he went again to the Wu-sun along the northern route, this time with several assistant envoys, 300 men, 600 horses, thousands of oxen and sheep, and gifts of gold and silkstuffs worth millions. From there Chang despatched the assistant envoys to Khotan, Ferghana, Sogdiana, the Oxus valley, Bactria, Parthia, and even India, while he himself returned with a sizable embassy from the Wu-sun state bearing gifts to the Chinese emperor. A year or so later the assistant envoys likewise turned up at the Chinese capital (Ch'ang-an) with natives from abroad, and we are told that "after this the countries of the northwest began to have intercourse with China." [4] Chinese silk and lacquered ware seem to have been greatly in demand abroad, the Chinese exchanging these (in part at least) for the famous horses of Ferghana. From five to ten or more embassies, or trading missions, often numbering several hundred men in

[3] Traditionally this activity goes back to the time of Fei-tzu, first ancestor of the house of Ch'in, who reigned 897-858 B.C.

[4] Among the presents received in 109 B.C. was a ewer (Laufer calls it "a Turkish wash basin") from the state centered on present day Kucha. It was a prize possession over six centuries later of the collector Liu Chih-lin (477-548).

each, went each year, and returned after an absence of several years. The discoveries made along these routes by modern explorers, such as Stein and Bergman, prove that the historical account is authentic. In addition to envoys and traders, several armies [5] followed these roads, and walls and watch towers were constructed (108 to 101 B.C.) in part to defend the section from Kansu to the salt marshes, a hundred miles west of Tunhuang. No word has come down as to the condition of these routes; probably they were little more than fairly well defined trails.

Old Trade Routes to China

4. The southernmost route ran from the Yangtze Valley (both from one central point such as modern Wuchang and from the Chengtu plain in Szechuan) by way of modern Kunming across

[5] Among them were the two famous expeditionary forces led by Ch'ên T'ang and Kan Yen-shou in 36-35 B.C., as a result of which the Chinese met and defeated the Sogdians and a small group of Roman mercenaries in a battle on the Talas river. For a description of the battle, see Dubs, *Amer. Jour. of Philology* LXII, July 1941, 322-340, and for a map of the route see Albert Herrmann, *Historical and Commercial Atlas of China* (Cambridge, 1935), 17. For reproductions of the oldest maps of central Asia, both European and Chinese, and of the ways followed, see Albert Herrmann, *Das land der seide und Tibet im lichte der Antike* (Leipzig, 1939).

the Mekong and Salween rivers to the Irrawaddy and so possibly to one of its many mouths; thence along the coast to the Indian peninsula. Naturally the precise stages of this route for early times can only be surmised. It seems increasingly clear, however, as our knowledge improves, that there were early connections between the peoples inhabiting the lands rimming the Bay of Bengal and those in central China. Wu Chin-ting (discoverer of the first black pottery site in Shantung) found in 1939-1940 at Ta-li, on the border of Yunnan near Burma, that the oldest period in certain sites excavated by his party was characterized by red gritty ware with imprinted decorative designs, which appeared to him to be related at some points to other ancient Chinese artifacts. Many years before, in the 1860's, John Anderson, director of the Asiatic Museum at Calcutta, made an expedition along the upper reaches of the Irrawaddy entering Yunnan via Bhamo. His collection of small axes and chisels made of rocks, found near Momein, suggested the same conclusion to the Italian archeologist Enrico H. Giglio. The approximate date of these stone tools or pieces of pottery is hard to come by. This type of culture may have continued after the beginning of the bronze age in north China. Around 1000 B.C. several introductions seem to have reached north China from the head of the Bay of Bengal. They include such innovations as "wet" rice, the domesticated fowl, and cattle of the zebu type.

These early importations are not at all surprising when we recall that the Chinese share kindred languages, social organization, and early religious ideas with the peoples of southeastern Asia, the Tibetans, Lolos, Burmese, Thai, and Miao-tzŭ, rather than with the Turki, Mongol, Manchu, and Korean of northern and central Asia. As both main branches of the Sino-Thai race have long been noted as traders, it seems likely that a certain amount of commerce flourished throughout this millennium.[6] Tin and yak tails were among the imports from the Burmese and Tibetan borders. By the latter half of the fourth century B.C. the state of Ch'u, then occuping a vast region covering most of central China from the Yangtze Gorges to the sea, attempted to gain mastery of the trade route to India. The

[6] There is an old tradition, which may be traced to the first century before our era, that at the beginning of the Chou dynasty, about the 11th century B.C., envoys of the Yüeh-shang tribe (Indo-China or Burma?), traveling on the backs of three elephants, arrived at the court, near modern Sian, with gifts of white pheasants. They said: "It is a long, long journey; there are mountains and rivers that impeded our progress. . . ." Another tradition, recounted in the unofficial history of this region, has it that the Pai-i, or Thai race of lower Yunnan and of upper Laos, traced their ancestry to the 9th son of a prince of Magadha.

general sent on this expedition never returned, however, but installed himself over the new principality, named Tien.

In 128 B.C., while on his embassy to the court of the Yüeh-chih in Bactria, Chang Ch'ien learned to his amazement that Chinese goods from southeast Asia were for sale in the local markets. He reported two years later to the Han emperor: "When I was in Ta-hsia, I saw there a stick of bamboo of Ch'iung [western Szechuan], and some cloth of Shu [the Chengtu plain]. When I asked the inhabitants of Ta-hsia how they had obtained possession of these they replied: 'The inhabitants of our country buy them in Shen-tu [India].'" Chang then recommended to the emperor that envoys be sent via Szechuan to India. The court heartily approved the proposal and organized exploring expeditions which took off from modern Chiating (in Szechuan) along four different routes. At each point they were blocked by hostile tribes, but they learned to their satisfaction that the Szechuanese traders did go to Yunnan for the export of their produce. Whereupon the emperor proceeded to the conquest (in 111 B.C.) of Nan Yüeh, comprising much of modern Kuangsi, Kuangtung, and Tongking, and at the same time absorbed the areas of Kueichow and Yunnan. This action put him in control of one of the richest territories of China, at one end of this great trade route. Apparently the emperor Wu, satisfied with the extent of his empire, decided to make contacts by sea with the other peoples who occupied this difficult route. He sent out a number of agents during the remainder of his reign (140-87 B.C.) and they touched at many points, possibly voyaging clear across the Indian Ocean. One point reached (Huang-chih) has been identified with the present Conjeveram, on the eastern coast of south India. They purchased, in exchange for gold and various kinds of silk, pearls, glass (or beryl), rare stones, and curious products. In the year A.D. 2 the kingdom of Huang-chih even sent a live rhinoceros to the Chinese court, but how it reached the Chinese court in north China is not vouchsafed to us. As can be surmised from this account we know even less of the above mentioned route than of the other three. The jungle has swallowed up the evidence.

FROM THE ENTRY OF BUDDHISM (1ST CENTURY A.D.) TO 1607

The missionary efforts of Buddhist monks from India, western and central Asia, and elsewhere touched not only the lives and civilization of China; they also affected and expanded travel on the highways and on the sea. Paralleling these journeys in the interest of their faith were also the come and go of traders, envoys, and military

officers and men. Of the four main routes mentioned above, the first three appear to have been most extensively used; there were times, of course, when hostile peoples blocked the way; at such times secondary roads were made to function.

In the years A.D. 73-102 the Chinese general Pan Ch'ao gained control of the two which skirted the Tarim Basin,[7] and traffic along these routes recommenced after a lull of several decades. Among the religious pilgrims who took them were such figures as An Shih-kao, prince of Parthia (ca. 148) and Chih Ch'an, a subject of the Kushan empire (ca. 170), early pioneers of a large number of followers of the Buddha. Going in the opposite direction was Chu Shih-hsing, first Chinese of 187 known pilgrims[8] in the next six centuries who sought to find the secrets of the new religion in the great houses of the faith in India and nearby lands; he arrived in Khotan in 259 and never returned. Several of these left descriptions of their travel. Fa-hsien, who started from Ch'ang-an in 399, took the northern road via Tunhuang, Shan-shan, Karashahr, Khotan, Karghalik, and Tashkurgan. At this point he went north to Kashgar, evidently to join the companions from whom he had become separated; thence back on his tracks to Tashkurgan, to undertake the crossing of the Pamirs and the Indus, and so by way of Darel and Uddiyāna to Gandhāra. To do this he was obliged to cross the river twice; the first time, he tells us, by a bridge of rope. He makes several remarks of interest concerning the route.

Of the initial stretch out of Tunhuang (a distance of 1500 *li*, or about 500 English miles, which his party covered in 17 days) he writes: "The prefect of Tun-huang had supplied them with the means of crossing the desert [before them], in which there are many evil demons and hot winds. [Travelers] who encounter them perish all to a man. There is not a bird to be seen in the air above, nor an animal on the ground below. Though you look all round most earnestly to find where you can cross, you know not where to make

[7] Nos. 2 and 3 above. For a part of the way there was a third or central road. Dr. Swann says that it "left the South Road not far out from the Jade Gate [near Tunhuang], crossed to Shan-shan [or Lou-lan] and the river bed beyond, turned northward and joined the North Road just west of Karashahr." *Pan Chao: foremost woman scholar of China, first century* A.D., 1932, 35, n. 37, and outline map on p. 29. This was the way followed by Fa-hsien (see below) and Chih-mêng (in 404).

[8] There were at least two well known Korean pilgrims, Hyön-t'ae and Hie-ch'o. The latter entered China ca. 723, went by sea to India, and returned by way of the Pamirs and central Asia. He reached Kucha at the end of 727. His observations on his travels, long lost, were found in fragmentary form by Pelliot in 1908 at Tunhuang, and have been translated into German by Fuchs.

your choice, the only mark and indication being the dry bones of the dead [left upon the sand]." (Translation here and following by Legge.)

Concerning the next stage, Karashahr to Khotan, we read: "They found the country uninhabited as they went along. The difficulties which they encountered in crossing the stream and on their route, and the sufferings which they endured, were unparalleled in human experience, but in the course of a month and five days they succeeded in reaching Khotan." Concerning the journey over the Pamirs, which took one month: "From this [the travelers] went westwards towards North India, and after being on the way for a month, they succeeded in getting across and through the range of the Onion mountains [or Ts'ung-ling]. The snow rests on them both winter and summer. There are also among them venomous dragons, which, when provoked, spit forth poisonous winds, and cause showers of snow and storms of sand and gravel. Not one in ten thousand of those who encounter these dangers escapes with his life."

Then the final stage into northwest India: "The travelers went on to the south-west for fifteen days (at the foot of the mountains, and) following the course of their range. The way was difficult and rugged [running along] a bank exceedingly precipitous, which rose up there, a hill-like wall of rock, 10,000 cubits from the base. When one approached the edge of it, his eyes become unsteady; and if he wished to go forward in the same direction, there was no place on which he could place his foot; and beneath were the waters of the river called the Indus. In former times men had chiselled paths along the rocks, and distributed ladders on the face of them, to the number altogether of 700, at the bottom of which there was a suspension bridge of ropes, by which the river was crossed, its banks being there eighty paces apart." [9]

Over a century later Sung Yun, an envoy accompanied by Hui-shêng and others, left Loyang in 518 to traverse the southern road en route to India. Their record [10] is less detailed but enumerates the following stages: Hsi-ning, Shan-shan, Tso-mo, Mo, Han-mo (later called Uzun-tati), Khotan, Karghalik, Tashkurgan, Po-ho (Wakhān), Po-ssŭ, Shê-mi (Chitrāl), Uddiyāna, and Gandhāra. Concerning the first stage, one of 23 days, they noted: "Along the road the cold was intense, the winds were high and the snow deep; the sand

[9] This crossing was to excite many a later traveler. Cf. the biography of the pilgrim Fa-yung who went with 25 other Chinese monks in 420.

[10] Both left travelogues, now lost, which were combined into one by a later author, published in 547.

and gravel which flew about filled one's view if one raised his eyes." (Translations by Beal and Chavannes.)

On the passage over the Pamir we read: "From this spot going westward the road into the mountains is oblique and precipitous; dangerous slopes stretch for a thousand *li*; cliffs hanging [in the air] rise to a height of 80,000 feet; obstacles which reach up to heaven, in truth it is there that one finds them.... After entering the Ts'ung-ling [or Onion] Mountains one creeps up gradually at each step; thus it goes for four days, and then one reaches the summit." Of the region of Chitral they record: "On the steep paths and perilous roads a single man and his horse hardly have space to go along. One route traverses the kingdom of Bolor to reach the kingdom of Uddiyāna; iron chains serve for a bridge, and, suspended over space, form a passage-way; below, one cannot see the bottom; on the sides one has nothing to cling to; in a trice one's body might drop to a depth of 80,000 feet. That is why travelers, seeing from afar the aspect (of these regions), renounce this route."

Still another century and we come to the greatest recorder of them all, Hsüan-tsang, who crossed Asia by the northern road (in part) and returned by the southern, in the years 629-645. The story of his journey appeared in 648; his own biography, written by a disciple, appeared in 688 and supplies additional details. Leaving China at the Jade Gate (near Tunhuang) he proceeded in northwesterly direction to Turfan; thence along the southern flank of the T'ien Shan via Karashahr and Kucha to Aksu; here he began the crossing of the mountains via Issik Kul (or Hot Lake) and reached Takmak on the northern flank; then west again to Talas, southwest via Tashkent to Samarkand, and south to Balkh and Gandhāra. After a long sojourn in India he returned (644) by way of Badakshan, Tashkurgan, Kashgar, Karghalik, Khotan, Pi-mo, Niya, south of Lob-nor, and Tunhuang. Telling of the mountainous crossing to Issik Kul, he writes: "The gorges of the mountain accumulated snow and retained their coldness spring and summer, and although there was the periodical melting the freezing set in immediately; the path was dangerous, cold winds blew fiercely. There were many troubles from savage dragons who molested travelers: those going by this road could not wear red clothes or carry calabashes or make a loud noise; a slight provocation caused immediate disaster; fierce winds burst forth and there were flying sand and showers of stones, those who encountered these died, life could not be saved." [11]

[11] Thomas Watters, *On Yuan Chwang's Travels in India*, 629-645 A.D. (London, 1904-05), I, 66. Watters supplies a useful map of the pilgrim's route.

Of the journey from Tashkent to Samarkand he says: "Northwest from the Sutrishan country you enter a great desert destitute of water and vegetation, a vast blank where only by following the mountains and observing the skeletons can the course be directed. Going above 500 *li* you reach the *Sa-mei-kan* country."[12] Concerning the way southwards the pilgrim remarks: "Here his path was a narrow risky track; there were no inhabitants and little grass or water. Traveling among the hills in a southeast direction for above 300 *li* he entered the Iron Pass. Along this Iron Pass on either side is a very high precipitous mountain. Although there is a narrow path in it this is still more inaccessible."

Of his return trip west of Badakshan he declares (inter alia): "From Ying po kan [Yamgan] he traveled southeast across mountain and valley by narrow dangerous paths for over 3,000 *li* to Ku-lang-na [Kurana]. . . . From Kurana the pilgrim going northeast over hill and through valley by steep narrow paths traveled more than 500 *li*. . . . To the northeast of Shang-mi, across mountains and defiles by dangerous paths at a distance of above 700 *li* was the Pamir valley. . . . From the center of the Pamir valley going southeast the road has no inhabited villages, over hills by risky paths where frozen snow prevailed, a journey of over 500 *li* brought the pilgrim to *kie-p'an-t'o* [Tashkurgan]. . . . From this going eastward he descended the eastern ridge of the Ts'ung-ling, over passes and through defiles by risky paths in a constant succession of wind and snow, for above 800 *li*, to the *Wu-sa* country outside of the Ts'ung-ling. . . . From this the pilgrim went north across hilly sand-heaps and waste plains for above 500 *li* and came to Ka-sha [Kashgar]. . . . Going east from this [Niya] the pilgrim entered the 'Great Flowing-Sand.' As the sand is in constant motion it is collected and dispersed by the wind. As there are no tracks for travelers many go astray; on every side is a great vast space with nothing to go by, so travelers pile up bones left behind to be marks. . . ."

Buddhist pilgrims continued to make their way across Asia for some time after Hsüan-tsang, but by the eleventh century they ceased altogether. The last sizable group to go (their number is put both at 300 and at 157) left for India in 966 and went by way of Hami, Turfan, Karashahr, Aksu, Kashgar, Khotan, Bolor (or valley of Gilgit), and so over the Pamirs to Kashmir; they appear to have returned by way of Nepal and Tibet.[13] Many envoys (cf. the em-

[12] *ibid.* 90. The original text here may be badly transcribed.

[13] This route was not often followed. But an occasional pilgrim, missionary, or official did take it, especially after 641, when the king of Tibet rejoiced in two wives, one a princess of Nepal, the other a lady of imperial Chinese blood,

bassy of the Byzantine Zemarchos to the seat of the Turkish khan in the T'ien Shan in 568-570, the envoy of Caliph Othman [651] and the three envoys of Harun al-Raschid [798] to the T'ang court); military officers (for example, Kao Hsien-chih, the Chinese viceroy of Korean birth, defeated at Talas in 751, and the Arabs who fought for the Chinese imperial army in the rebellion of 756-763); students (many who enrolled after 631 at the national academy at Ch'ang-an came from Kao-ch'ang, Turfan, etc.); missionaries (Buddhist, Mazdean, Nestorian, and Manichean); merchants (contemporary records tell of central and western Asiatic traders in Ch'ang-an, and we surmise from documentary remains that Jewish traders penetrated both Khotan and Tunhuang); painters (cf. Po-chih-na and his son I-sêng who came to Ch'ang-an from Khotan about 627); and dancing girls (Sogdiana and other kingdoms sent dancers to the T'ang court after 713)—all these and others point to a considerable use of the central Asian routes, especially in the seventh and eighth centuries. For the most part, however, they left little or no account of the roads they followed; at least, the Chinese remain the most explicit [14] with the exception of two Arabs.[15]

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and before 751 when the Thai kingdom of Nan-chao (centered at Ta-li in Yunnan) inflicted a bloody defeat on a Chinese army, and made an alliance with the king of Tibet. This effectively closed the route for some time to come. The best known traveler to follow this way to India was Wang Hsüan-ts'ê. He went to India at least three, probably four times, in 643, 648, 657, and (?) 663. Others included the Chinese pilgrim Hsüan-chao (ca. 641-650), the Korean monk Hyön-t'ae (ca. 650-655), and the Indian missionary Subhakarasimha (ca. 716). Hsüan-hui (7th cent.) planned to return from India by this route, but fell ill in Nepal and died there. Chavannes suggests that the number of Chinese pilgrims who died in Nepal may have been due to the rigors of its climate. Another reason for its unpopularity was possibly the fear of being waylaid en route. Hsüan-chao had to delay his return from Nepal for this reason. The first and third emperors of the Ming exchanged envoys with Nepal, all probably going by way of Tibet. The route via Lhassa taken by one of them, the eunuch Yang San-pao, is given in the Ming history, but without comment. The first Europeans to attempt this journey were the Jesuits Grueber and Albert d'Orville in 1661-1662. The latter, overcome by the experience, died after reaching Agra. No other known occidental followed in their trail until the 20th century.

[14] The Chinese geographer Chia Tan (730-805) listed the important trade routes of his time including those to Mongolia and across Asia but does not discuss the condition of the roads. One went south of the T'ien Shan, crossed it via the Bedel pass, and ended at Aulieata on the Talas river. A second (called 1 above) took the way north of the T'ien Shan, touched at Urumchi, crossed the Manas and Black rivers, traversed the Iren-khalibirga, then debouched in the Ili valley, so connecting with the first road at Tomak. A third, information on which is derived from other contemporary Chinese historical sources, took

[15] (See Page 28 for footnote.)

Beginning with the thirteenth century the whole of middle Asia teemed with activity as never before. For a few decades Karakorum suddenly became the center of the Euro-Asiatic world. Here in the years 1204-1206 Jenghis emerged as master of all Mongolia; from here he and his successors launched campaigns east and west and south. The routes their armies traveled (1, 2, and 3 above) took on new meanings, for men and supplies had to be transferred swiftly over distances vast by any measure, and envoys and officers had to come post haste at the khan's bidding. Fortunately a number of reports of these roads survive, beginning with those of the Khitan minister Ye-lü Ch'u-ts'ai (1218-1219), of the Chin envoy Wu-ku-sun Chung Tuan (1220), and the Chinese Taoist priest Ch'iu Ch'u-chi (1221-1224)[16] and continuing through those of Friar John of Plano Carpine, Friar William of Rubruck, Marco Polo, Friar Odoric of Pordenone, and Pegolotti. While there were still long stretches of primitive pathway, there were undoubted improvements. Ye-lü wrote of Jenghiz's initial and successful effort to cross central Asia.

In 1219 "a vast army was raised and set in motion toward the west. The way led through the [Altai] mountain. Even in the middle of the summer, masses of ice and snow accumulate in these mountains. The army passing that road was obliged to cut its way through the ice." (Translation by Bretschneider.)

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off from Karashahr, followed the valleys of the Khaidyk-gol and Yulduz and the Narat pass to reach the Kunges river, and so brought a traveller to Ili. A fourth is suggested by the biography of Shan-wu-wei, an Indian missionary to China (d.735), who seems to have gone east from Kabul or Kapisa into Kashmir, crossed the Himalayas, skirted the Hindu Kush, passed through northwestern Tibet, then travelled north to join the great thoroughfare at Turfan (route 2), whence he journeyed to the Chinese capital in 716; unfortunately no details concerning the first part of his journey have come down.

[15] These two were Ibn Khurdadhbih (or Khordadzbeh), d.849, and Abu Sa'id 'Abd al-Haiy Ibn Duhak Gardizi, who wrote his *Zain al-Akhbar* about 1050. Hartmann writes of the former's discussion of the land route from Transoxiana to China: "He describes in thrilling fashion the skill with which these mountain Turks [in Badakshan] traveled through the great deserts of rocks where no path was visible." The latter's itinerary from Turfan to Khamdan (modern Sian) runs as follows, according to Hartmann: "Cinandjket [Turfan] . . . to Komul, 8 days; at Bagh Shura [?] the river has to be crossed by boat; thence it is 7 days' journey across the steppe, which has springs and pasture, to Tunhuang; thence 7 days to Suchou; thence 3 days to Kanchou; thence 8 days to Kuca [?]; then in 15 days to a river, which is called Kiyan [Yellow river?] and has to be crossed by a boat. From Baghshura to Khamdan, which is the capital of China, is a month's journey; there are good rest-houses at the stations on the road."

[16] Note especially the map in Arthur Waley, *The Travels of an Alchemist* (London, 1931), facing the title page.

Ch'iu Ch'u-chi's recorder again and again mentions the wagons which were part of his caravan. This is a new note. For example, of one point in western Mongolia crossed in the summer of 1221, he wrote: "On the 28th day we halted to the east of the Ordo, and the Mongol Commissioners went on to inform the Empress of our arrival. Her Majesty requested the Master to cross the river [Chagan Olon] which here flows to the north-east. It was so flooded that the water came above the axles of our cart-wheels and we were obliged to go right through the water in order to get across. We were soon inside the encampment; and here we left our wagons. On the southern bank of the river were drawn up hundreds and thousands of wagons and tents." (Waley's translation). While in the Altai, he says: "The country was now so mountainous, the ascents so formidable and the valley-gorges so precipitous and deep that the use of wagons became very difficult. The road here was first made for military purposes by the Great Khan's third son." A little further on, the record reads: "When we started on our night journey our oxen were all incapable of further effort, and abandoning them by the roadside we harnessed six horses to our wagons. Henceforward we did not again use oxen." After leaving Belasagun, he states: "We now heard that the road in front of us was very difficult going. One of our wagons had broken down and we were obliged to leave it behind." At Samarkand, he declares, with apparent relief: "Here we brought our wagons to a stop." Three years later, on his return to Peking, Ch'iu traveled both by wagon and on horseback.

Within a few years conveniences for speeding message bearers, officials, and traders on their way greatly developed. John of Plano Carpine tells of the relays of horses provided for him by the Mongols which he used to go with all haste (in 1246) to the kuriltai of Ogodai. Rubruck a decade later mentions the post stations which so stirred the imagination of his great successor, Marco Polo. Pegolotti, writing about 1340, also refers to the stations, and reassures his readers: "The road you travel from Tana to Cathay is perfectly safe, whether by day or by night, according to what the merchants say who have used it." But he is factual enough to make this exception: "You may reckon also that from Tana to Sara the road is less safe than on any other part of the journey; and yet even when this part of the road is at its worst, if you are some sixty men in the company you will go as safely as if you were in your own house." As to the method of travel, he adds "Merchants who travel this road can ride on horseback or on asses, or mounted in anyway that they list to be mounted." He likewise mentions camel wagons for the first part of the journey. The speed people could make, if desired,

was phenomenal. Michael Prawdin estimates that in 1224 Subotai, "bandaged head and trunk," and riding day and night covered in a little more than a week 1200 miles.

The administration of these postroads and courier stations is worthy of brief notice. They were placed generally under the military department, a division subordinate to the Grand Council. Each station was controlled by a station master, or, in cities of importance, by the local magistrate. Outside of China, where the head office was in Khanbaliq (modern Peking), there was an office in Karakorum. The system must have begun early in the days of Mongol conquest for it is mentioned in the *Secret History of the Mongols* compiled in 1240. At these stations were couriers who carried news to the khan or emperor and took his messages far and wide. There were also grooms who looked after the animals and equipment (horses, oxen, donkeys, carts, and even boats for travel by water are listed), and provided escort for envoys, important property, and tribute. Other officers seem to have served as agents for inspection of envoys and couriers to prevent misuse of the roads and stations. Post families, who were responsible for livestock and supplies, had significant functions. Such a system, with so large a measure of autonomy, was bound to suffer from frequent abuse. Many officials held up envoys and travelers bearing merchandise, and embarrassed the central authorities so that they had to step in.

Not long after Pegolotti issued his remarkable manual for merchants, the great routes of Asia ceased to be the free and relatively safe threads of contact east and west. Islam spelled their doom at one terminus and the resurgent Chinese put an end to them at the other. An occasional envoy and trader was an exception. The first emperor of the Ming (1368-1398) and Timur (1369-1405) and their immediate successors exchanged ambassadors; and Clavijo, the Castilian traveler, wrote that in 1404 "as many as 800 camels, laden with merchandise, come from Cambalu to Samarkand in the month of June." (Translation by Bretschneider.)

Actually, however, we must wait for the journey of the Jesuit lay brother Bento de Goes (1562-1607) to gain a clear picture of the state of one of these routes in the next two centuries. Goes started for Kashgar in 1603, and traveled, as the map in Wessels' book shows, along the second route, via Yarkand, Aksu, and Hami to Tunhuang. Safety was a thing of the past. His caravan was frequently set upon. In the district of Badakshan he speaks of "eight days of the worst possible road." (Translation by Yule.) At Tangitar one of his companions, Isaac the Armenian, fell off the bank of a river and nearly perished. Near Yarkand "the roads were so bad

that six of our brother's horses died of fatigue." From there on he tells of a 25-day journey to Aksu and reports: "the difficulties of the road were great, either from the quantities of stones or from the waterless tracts of sand they had to pass." A 15-day rest, and off they started again, this time to Kucha. The refrain is the same: "They halted a whole month to rest their cattle, for these were nearly done up, what with the difficulties of the road. . . ." Gone were the days of the Mongols when speed and safety and plenty of mounts, if not comfort, were the order of the day.

That the fourth route (No. 4 above) was occasionally used is clear, but nothing like the same number of travelers seems to have taken it. A few years ago there were discovered at Chao-t'ung, Yunnan, several pieces of stone sculpture bearing a date equivalent to A.D. 83. One was said to be a carved pedestal for Buddhist figures. If this be true it is interesting, but not surprising evidence of early Buddhist penetration, probably via Burma. Early historical literature supports this indication of direct connections with the West by way of Burma and Yunnan. *The History of the Later Han Dynasty* recounts the arrival in China in A.D. 120 of a group of musicians and jugglers, all natives of western Asia, who reached the region of Yunnan and went thence to amuse the imperial court at Loyang. During the next few centuries (third to sixth) this route, "the Burma Road," continued to be used, especially for the import of goods from Arabia and the Roman Orient. In the next three hundred years it remained a well known way of travel as both histories of the T'ang and other works attest. The kingdom of P'iao (i.e. Pyū) in Burma and the kingdom of Nan-chao in Yunnan seem particularly to have been en rapport. For example, in 802, when the latter submitted to the T'ang empire, the king of P'iao sent his brother to China to present an orchestra of Burmese musicians, and five years later another P'iao embassy arrived at the T'ang court together with envoys of Nan-chao.

The main route from China running westwards left Yunnan at Yung-ch'ang on the Mekong river, crossed the Salween, reached the valley of the Irrawaddy, traversed northern Burma to the Brahmaputra in Assam, and went thence to Magadha and across northern India to Afghanistan. Much of this, especially the first part, must have been exceedingly difficult. Unfortunately we have no intimate accounts concerning the conditions of the road or roads. Hsüan-tsang, who picked up some information by hearsay while on the Indian frontier, describes as follows the route across Assam: "To the east of Kāmarūpa, the country was a series of hills and hillocks without any principal city, and it reached to the south-west bar-

barians [of China]; hence the inhabitants were akin to the Man and the Lao. The pilgrim learned from the people [of Kāmarūpa] that the south-west borders of Szechuan were distant about two months' journey, but the mountains and rivers were hard to pass, there were pestilential vapours and poisonous snakes and herbs." (Translation by Watters.)

Marco Polo, who touched at Yung-ch'ang but probably never went beyond, says of the journey into Burma: "When one leaves [Yung-ch'ang] . . . one begins to go down by a very great descent. For you may know quite truly that one goes riding quite two days marches and a half on the decline. . . . Then one finds a great province which is toward midday and is on the borders of India. . . . And through it one goes fifteen days marches by very out of the way uninhabited places and through many woods and great forests where there are elephants enough and unicorns enough and many lions and other strange wild beasts in great plenty of all sorts. There are no men or dwellings. . . ." (Translation by Moule.) In this Marco is probably describing the trail from Yung-ch'ang to Tagaung or Old Pagan on the Upper Irrawaddy. Their word pictures of the difficulties encountered explains why this route, though known, seems not to have been taken by any of the great medieval travel writers of China, the Buddhist pilgrims. It was known, however, to Marco's contemporary, Rashid-eddin, and to a Chinese of the next century, Wang Ta-yüan, who wrote ca. 1349: "There is a land route from Yunnan which, in a year or more, leads to Mecca."

CONCLUSION

It seems evident from our sources that such roads across Asia as have existed, though very old, have in general remained primitive. In fact, until this century, little thought has been given to constructing highways between East and West suitable for regular vehicular traffic.[17] The costs were too great for the volume of business and the amount of journeying to and fro. Even now, as the testimony of modern travelers indicates, travel in central and southern Asia remains a difficult proposition, but changes for the better are probably impending.

[17] Sven Hedin has written that in 1934 he was in the Lop-nor country, entrusted by the Chinese government "with the task of localizing and investigating two motor-roads between China proper and Sinkiang." Only the impact of war has led to the construction of the Burma and Ledo roads.

4 THE ROMAN EMPIRE HIGHWAY SYSTEM

BY M. P. CHARLESWORTH

The communications system of the Roman Empire was never a single planned whole, but rather the expression of the growing and developing policy of the rulers of that Empire, as they incorporated new territories or had to face fresh dangers. Nowadays the phrase "Roman road" is so familiar that we may fail to enquire what new thing it represented. Years before the Christian era statesmen of the Roman Republic had the wisdom to grasp the importance and utility of a highway with solid foundations and level surface, which would facilitate the rapid concentration of troops at a given spot and enable Roman generals to be "firstest with the mostest": their successors in the Empire possessed the manpower, the resources in money, and the engineering skill and practice, to carry a system of communications over an enormous area comprising southern and western Europe, the south shore of the Mediterranean, Egypt, Syria, and Asia Minor.

A great road system is possible only in states that have a strong central government, labor-power, and an engineering tradition. Five centuries earlier the Persian Empire had certainly possessed "Royal Roads" for the relaying of despatches, by which armies too could march; but except within (and for a short distance without) its cities it had apparently nothing like a properly paved and engineered road. Ancient Greece, with its exiguous city-states, depending upon sea-transport, did not need and could not afford great roads: famous Sanctuaries had "sacred avenues" leading to them, there existed a paved carriage-way between Athens and its harbor, Piraeus, but most early Greek roads were tracks, and in one speech of Demosthenes it can be seriously debated whether a piece of land is a garden, a stream-bed, or a road.

By contrast Italy and the provinces of the Empire were intersected by roads that gave through communication from one limit to another, that were carefully laid on deep and solid foundations, and provided with proper drainage; whose course was planned as directly as possible and skillfully related to mountains, rivers, or marshes. Their level surface made wheeled traffic practicable, and milestones gave the traveler the necessary information. In the strength and solidity of their construction—the Latin word for making a road also means fortification (*munire*)—in their progress, un-

impeded by natural obstacles, they left an indelible impression of the majesty and might of the Empire which laid them.

A certain number of ancient texts describe the way in which a road should be laid, but it may be doubted whether any except the main trunk-roads were constructed in full accordance with this ideal. For more technical details the reader should turn to the books mentioned in the Bibliography (especially Collingwood, Forbes, Grenier, and Daremberg-Saglio); here only a general account can be given stressing the chief aspects. The road might vary in width from 24 to 12 feet (or even 8 feet over high and rocky passes), according to its importance. It was based on a carefully laid bottoming of large stones planted upright in firm soil or clay; above this bottoming came a layer of rammed gravel, small stones, or crushed brick and sand; above this might come a surface layer (on the great roads) of large polygonal slabs of stone (varying according to the country) carefully cambered; on the lesser roads gravel and sand or cinders might form the top layer, properly rolled and cambered. Surface water drained off into gutters or ditches that ran on each side.

Roman roads were not, of course, uniform in dimensions, and we should distinguish those which may be called specifically "military" from those which probably served more for civilian and commercial purposes. First come the great strategic highways, connecting Rome with the provincial capitals and the frontier camps. These take the quickest and most direct route, overcoming natural obstacles as far as possible. For examples: the Via Appia is borne across the Pontine Marshes on a fine embanked causeway, and Roman engineers quickly adapted the "corduroy" system of construction to carry their troops through the marshy country of the Dutch-German borderland on the logroads they called the *Pontes Longi* (Long Bridges); in the rocky defile of the Danube, a path was hewn out of the cliff side at the Kazan gorge, and the road was carried upon wooden planks let into the cliff.[1] Sometimes, where a bluff of rock presented difficulties, Roman engineers were prepared to tunnel; in the Furlo Pass, southeast of Fossombrone, they bored one 126 feet long and 17 feet high and broad, which is still in use; shorter ones can be traced at the Pierre Pertuis (near Tavannes, Switzerland), and above the gorge of the Romanche, north of Bons (Haute Savoie, France). Small shallow rivers would be crossed by a paved ford; larger ones spanned by arched masonry bridges, remains of which may still be seen in France, Spain, Turkey, and Syria; estuaries were crossed by ferries, such as that from which

[1] Traces of a similar device have been found near Bourg d'Oisans (Isère).

modern Utrecht derives its name (*Traiectum*). In connection with these larger roads should be mentioned the patrol-roads, along which cavalry would travel from time to time to survey the state of the country; to this category we may probably assign High Street in Westmorland.

These great military roads were built, kept in repair, and managed generally by the imperial government, through its officials. Along these, at about 25-mile intervals, were situated posting-stations, with relays of horses, so that the imperial communications-system (*Cursus publicus*) could function efficiently. To a second class belong those which connected important centers and provided alternative routes (sometimes along the line of older native tracks), and in some places to assist the exploitation of a particular district. Most of these are later in date than the main trunk roads, and show a less solid, though still sufficient, foundation and filling. Many of them would be built and paid for by the municipalities or by the inhabitants of a district, and kept up by requisitioning local labor. To this category we may assign some of the roads in northwestern Spain, probably intended to exploit the immense mineral wealth of that region, the roads that served the mines in Transylvania, and the Maiden Way in Cumberland, which crosses the Pennines in close proximity to ancient lead-mines.

But even these would not provide for all purposes, and there remain what may be termed "local" roads, and also private roads. Many of these local roads were doubtless simply the older native routes and tracks, their course straightened and improved, and provided with a proper roadbed and metal. These would serve the needs of the countryside, of people coming to market, of hawkers, farmers, and small tradesmen. Their quality and standard would depend much upon the wealth of its region; a rich district would doubtless want the work carried out in style, a poorer one would have to be content with what it could afford; a wealthy citizen, eager to display his public spirit, might often defray much of the expense. The total mileage covered by all these different roads must have been immense; any good map of the ancient world, or of the provinces of the Roman Empire, will give a fair idea of the bigness and complexity of the system, and it must be remembered even now we do not know *completely* the whole road-system.

The trunk-lines of this extensive network were due originally to strategic needs; as Rome slowly included central and south Italy in its grip, and then the North, so her roads slowly crept forward. First and most famous, the Via Appia; it was designed originally to connect Rome with Campania, in later centuries was extended to

Beneventum, and finally to Brundisium (Brindisi), from which harbor forces could be shipped to the East. As Rome's interest in the East increased came the Via Egnatia, which crossed the northern Greek mainland, starting from Dyrrhachium (Durazzo) and coming down to the north Aegean at Thessalonica (Salonica); this was a work of the second century B.C., and late in the same century the Via Domitia was initiated, which ultimately provided passage across the South of France and into Spain. Under Augustus (31 B.C.-A.D. 14) speedy communication with the provinces became more urgent: Augustus himself completed or renewed the road across Spain to Gades (Cadiz); his great lieutenant, Agrippa, supervised the planning of a road system in France, which gave quick routes to Bordeaux, the Channel ports, and the legionary camps upon the Rhine. His stepson Drusus began the construction of a trans-Alpine highway, which was eventually finished by his son, the emperor Claudius; it provided a direct route from the Adriatic by Trento, over the Brenner and Reschen-Scheideck passes, into the Inn valley, and on to Augsburg and the Danube. Claudius, too, constructed a route over the Western Alps by the Great St. Bernard to Augst (nr. Basle) and on to the Rhine camps. The governors of Britain, under Claudius and Nero, laid down the lines for the road system of newly-conquered Britain; today for many miles, on Watling Street or Great North Road, the motorist still travels on a route provided by the Romans.

With the opening of the second century danger from the Northeast and the East was becoming more threatening: to meet it Trajan constructed a great trans-European highway, from the Rhine to the Black Sea, which would enable him to move legions swiftly where needed. The oath which he swore, to bridge both the Aufidus (Ofanto) in Italy and the Danube, shows the importance which he attached to perfecting the road system, for his Via Traiana, bridging the Aufidus, shortened the time for transport from Rome to Brundisium, and his bridge over the Danube at Turnu Severin (built by the greatest engineer of the time, Apollodorus of Damascus), was the supply-line for the Romans fighting in Dacia (Transylvania). Throughout the second century his successors persevered in the work of repair and maintenance, as did another warrior emperor, Septimius Severus. In its general intention the road system of the Empire may be compared with the strategic railways so carefully laid down in the second half of the nineteenth century by France, Germany, Austria-Hungary, and Russia, or with the *Autobahnen* so solidly constructed by the rulers of the Third German Reich. But such means of communication can be used both

ways, as the invasion of Germany has recently demonstrated;[2] in the middle of the third century a flood of barbarians poured over the defences of the Empire; these barbarians could utilize the excellence of the Roman roads in attacking their makers, especially so in an age when explosives were unknown and masonry bridges not quickly destroyed. Yet, by heroic efforts, the breaches were slowly sealed, and unity restored to the shattered realm. During the end of the third and early years of the fourth centuries, repair and reconstruction went on patiently; communications were restored. When Constantine the Great inaugurated his "New Rome" at Constantinople in 330, he was acknowledging by his action what the logic of events had made clear, that the center of communications lay on the Bosporus. But the fact that few new roads, except one or two in Anatolia, had to be built then, shows with what foresight his predecessors had developed the network.

The restored Empire was not, however, to last for long. A terrible defeat at Adrianople in 378 resulted in the severance of the trans-European land-line; when, a century later, the Vandals occupied Sicily and Sardinia, and controlled the western Mediterranean with their fleets, sea-communications were also cut, and the complicated structure of imperial communications was fatally damaged. War and neglect soon made such inroads that in 426 Rutilius, traveling back to France from Rome, had to take ship, since bridges were broken down and brigands about. The barbarian rulers who occupied the older western provinces had not the imagination or the resources to keep roads in repair. The Eastern Empire did indeed preserve its integrity for many centuries, and we find the emperor Justinian building a long bridge over the Sangarius (Sakariya) in 561. But in the West the splendid fabric slowly decayed; even so it is worth remembering that the old road system formed the background to many campaigns in the early Middle Ages, and that today in Western Europe many parishes and communes still have boundaries that lie upon what was once a Roman road.

Such, in barest outline, is the story of the imperial highway system. Its nucleus, undeniably, was the strategic roads, intended to safeguard and defend the Empire. But in its development, with innumerable connecting links and local roads, it certainly served other and more pacific purposes. It was not unimaginatively uniform; Roman engineers, with the training and tradition of centuries, paid no slavish obedience to the straight line; they could modify preexisting tracks, they knew how to adapt themselves to local needs and local materials. Literary texts, inscriptions, and art all

[2] This was written in April 1945.

alike bear witness to the constant traffic in goods, light and heavy, between the different provinces. Even though carried principally by sea, it must have been also by road that Egyptian serpentine and red granite were brought to decorate Belgian villas, that Derbyshire "Blue John" reached Italian towns, that Syrian or Italian glassware spread to the western provinces. Connoisseurs in Italy could choose between Belgian or Spanish hams, could order Gallic cloaks and hoods, purchase oysters from Britain, and buy nuts, figs, and dates from Syria. Along these roads there sprang up, often with the encouragement of the government, new trading and market centers—Viroconium (Wroxeter), Virunum (near Klagenfurt), Augustodunum (Autun), and many others, where urban civilization could begin and the natives learn the responsibilities of local self-government. Many were the travelers they carried: from the small local pedlar to the merchant who traded in silks and jewels; from the solitary trader plodding along under his pack to the wealthier one riding with his wife and slaves in a wagon; government officials, with the right to demand horses and supplies, soldiers on leave, wealthy burghers trotting in from their country houses to an office in town, doctors, traveling lecturers, slave-dealers, itinerant musicians and entertainers, carpenters and craftsmen—all might be met. Their needs were supplied by hotels and inns, good and bad; at the summit of mountain passes were stations for shelter and comfort. This is no fancy picture; it can be supported by the evidence of literary documents, inscriptions (which show how much men could travel from one province to another), sculpture, and excavations. Security generally was assured by the Pax Romana. In the more mountainous districts, where brigands might be feared, small bodies of soldiers were stationed to enforce law and order. River traffic, too, was considerable, for this was a cheaper and more convenient method for bulky freight than the springless and clumsy cart, and the inefficient harnessing, which was all the ancient world knew. On the great rivers of western Europe there were corporations of shippers and barge-owners. In some places stretches of river were canalized, as the south Rhone was by Marius's dikes; in others new waterways were constructed, such as Corbulo's canal connecting Meuse and Rhine, and in eastern England the Car Dike, which was apparently intended as a link between the river Trent, Lincoln, Peterborough, and Cambridgeshire. An even more ambitious project, to connect the Saône with the Moselle and thus to provide through shipping between the Mediterranean and the North Sea, was never carried into effect.

But these roads carried more than material goods: in facilitating

intercourse among members of the Empire they helped spread not only the Latin language, but also new ideas, cults, and faiths. St. Paul, greeted at the end of his long journey by the Christian brethren who had come as far as Appii Forum to welcome him, is a familiar example. But there were many others: Roman peace and Roman roads were great agents in the diffusion of Christianity, and of such cults as those of Mithras or Isis, and all found travel easy, when there were no passports (except perhaps for Egypt). The total effect of this through four centuries must have been tremendous. Easy, rapid, and secure travel between England or France and Egypt or Syria was a blessing not realized between the end of the Empire and the middle of the nineteenth century. The impression left, too, on succeeding generations was abiding: these great roads beyond the resources of the small Middle Age kingdoms, must be the work of semi-legendary rulers or of the devil himself. Place-names in modern France or Belgium or Spain still recall the trace of a Roman road; in England the modern names "street" or "highway" go back to Anglo-Saxon impressions of the paved and raised causeway that the Romans had left. To take another instance: these roads made possible the spread of the Latin language; Latin provided the base for the languages of Belgium, France, Spain, and Portugal—not to mention distant Roumania— and modern scholars, studying dialects, still find it useful to investigate thoroughly the Roman road system of the district in which they are interested. If communication is civilization, or at any rate one of the main factors in it, by their roads the Romans laid the solid foundation for a thriving culture that through the ages still exerts its influence upon the twentieth century.

5 THE HISTORY OF THE MODERN HIGHWAY IN ENGLAND: AN EXAMPLE SHOWING THE PERMANENCE OF A RIGHT OF WAY

BY SIR ALKER TRIPP, C.B.E.

From time out of mind the English populace possessed a common-law right to use any highway, the right being confined to passing along it. But the ancient highways of long ago were continually falling into disrepair through lack of regular maintenance, and another common-law right came thus into being, a right to go upon adjoining land even to the extent of "going upon the corn," if the road were "so foundrous as to be impassable or incommodious." The lamentable condition of many of the roads led in turn to a third rule of common law, whereby the inhabitants of every parish were bound to keep in repair every road in their parish to which the public had by law a right of access. These principles were early established.

The local inhabitants, who were "of common right" bound to repair their own highways, found this duty a real burden; not only were they required to devote unpaid labor to road repair but they often had to provide the road-material in addition. The system was not wholly equitable, because—although the roads were mainly useful for through traffic—the whole burden of repair fell upon the parishes through which the road passed. None the less this enlistment of unwilling labor continued for centuries, and the quality of the roads was correspondingly poor; really better roads were in fact obtained only when the main burden was shifted from the local inhabitants to the travelers who used the roads. This was brought about by laws which empowered certain corporate bodies to take tolls from road users, the proceeds being used to keep the roads in repair. In this way the "Turnpike" system developed in the eighteenth century, a system whereby Parliament authorized gates or turnpikes upon various main roads for the taking of tolls. The right to use the highway remained, but only after toll had been paid. The turnpike system continued to be more and more widely applied until the advent of the railways, after which the toll-bars gradually disappeared from the major roads, and the responsibility for upkeep was taken over by the county and other local authorities. There are still a few points at which tolls can be demanded, but

elsewhere throughout the country the old right of way has been reasserted, without let or payment.

AN OUTLINE OF HISTORY

Prehistoric Tracks. The earliest trackways in Britain, which were of very great antiquity, served not only internal movement in the country, but also trade with Gaul which existed as far back as the Bronze Age. One of these ancient trackways ran right across the south of England from Cornwall to Kent.

Roman Roads (A.D. 43-407). The plan of the Roman roads was largely determined by military considerations, and the roads were designed primarily for pedestrian traffic. Much of the system of old British trackways was adopted, the tracks being improved, straightened, and resurfaced. London (Londinium), an inland port, was the chief nodal point of the road system, having six main roads radiating from it. The Roman roads followed the uplands rather than the valleys, and were carried well inland, not along the coasts; much of their length seems to have been on embankments. So well were they built that the stones themselves have been found to be more easily broken than the cement. "No engineering work comparable with the Roman road system was seen in England till railways criss-crossed the land;" [1] and "the subsequent history of the roads of England might almost be said to be the history of how and why the Roman roads have come to be the modern trunk roads." [2]

The Dark Ages (475-1137). For many centuries there was no progress; the old road system degenerated through neglect. Bridges fell into ruin and portions of the roads themselves disappeared. Gradually, however, the churches and monasteries, as a service to mankind, took an interest in the roads, not only in maintenance and repair of the track but also in the building of bridges.

The Middle Ages (1137-1453). In the Middle Ages the amount of road travel considerably increased. When parts of France were subject to the English throne there was a good deal of movement between the two countries. Pilgrimage also became a national habit, and the pilgrim-shrines in England were very numerous; the wayfaring life of the period still lives in the pages of Chaucer. The minor roads which were developed during this era had scanty foundation, or none at all; and the road itself was little more than an established right of way; these tracks were carried round any obstruction which they encountered, such as woods or corn lands,

[1] T. W. Wilkinson, *From Track to By-Pass, A History of the English Road* (London, 1934), 23.

[2] Ruth M. C. Anderson, *The Roads of England* (London, 1932), 49.

a fact which accounts for the tortuous course of so many rural roads in the present day. Passage on these roads was extremely slow, and "even a royal messenger, who might be expected to have special facilities, was allowed forty days for the journey to Scotland and back."[3] The only progress discernible in this period was in an increased amount of bridge-building. There was little wheeled traffic, the roads being, in effect, bridle-ways, and "heavy materials were taken by water, going by small boats far up the most insignificant streams."[4]

A new departure was made in the thirteenth century when the Crown, in certain special cases, granted to some corporate bodies the right to take tolls, which were called "pavage," for keeping their roads in repair.

Transport by Pack Horse. This mode of transport continued from early days until the eighteenth century. Causeways for packhorse traffic had greatly developed during the Middle Ages: they were narrow tracks, raised and paved, which were for the most part parallel to the primitive roads. Bridges, steep and narrow, were built where rivers or streams had to be crossed, for, if fords were used, the merchandise in the panniers would be damaged. The causeways were of special value in low-lying lands, where the tracks became quite impassable in winter. They were, however, often so narrow that it was not possible for packhorses to pass one another, and one or other had to descend into the mud.

Tudor and Stuart Periods (1485-1714). When Henry VIII abolished the monasteries, the church ceased to afford its previous help to road maintenance, and the state of the roads became parlous. At much the same time, commerce began to increase. Previously the communities throughout the country had been self-supporting, and had depended upon local fairs and markets for exchange of goods; the Tudor period saw the commencement of wider commerce, and the development of larger towns. For trade purposes better roads were essential. Laws were passed in regard to particular districts where the roads were "right deep and noyous," and exposed travelers to "great pains, perils and jeopardy." Repair and maintenance were also entrusted by statute (1555) to "surveyors" in every parish, and parishes which neglected their roads were heavily fined. The unpaid labor on the roads thus became statute labor; and one of the effects was that, instead of roads being widened on account of the increased commerce, the tendency was to

[3] *ibid.*, 65.

[4] Sidney and Beatrice Webb, *English Local Government, The Story of the King's Highway* (London, 1913), 8.

make them narrower, thus reducing the amount of labor. In order to prevent undue wear and tear, restrictions on traffic were imposed (in the Stuart period) in regard to weight limits and width of wheels, while on certain roads in towns, carts "shod with iron" were prohibited. A more important development was an Act of 1663, which authorized the collection of tolls from passengers of vehicles at certain points on the North Road, funds being thereby obtained to put the road into a thorough state of repair. The turnpike system was the next development.

The Turnpike Roads. A turnpike road was a road on which a turnpike was erected under statutory authority; the public were bound to pay tolls, and anyone who refused could be turned back. Certain individuals subscribed among themselves for the repair of such roads, and recouped themselves from the tolls.

In the eighteenth century and the earlier part of the nineteenth, the turnpike system gradually spread more and more until all the main roads of the country became toll roads. The system was violently opposed at first, and rioting occurred when "by day and night disorderly persons cut down, pulled down, burned and otherwise destroyed turnpike gates and houses." Troops had even to be called out to deal with the tollbar-breakers. None the less it is computed that more than a thousand Turnpike Acts were passed between 1785 and 1810, and that in all there were more than four thousand acts of this character. The general result was a very great improvement of the road system as a whole, and "turnpike roads were constantly treated by the legislature on the assumption that the traffic upon them was more important than the traffic upon an ordinary highway." [5]

In 1836 a committee of the House of Commons reported adversely to a continuance of turnpikes, and the process of "disturnpiking" then set in, but the turnpike system on public roads "did not come to an end until 1895 when the last toll was taken under Statutory powers in the island of Anglesey." [6]

The Coach Roads. Though stagecoaches had come into being about 1640, their operation did not become a regular service until after 1784, when the mails (between Bath and London) were first carried by stagecoaches. Within a few years of that date mailcoaches were running nightly from London along all the main roads. Newspapers were distributed by the same agency. Better roads and more rapid journeys were demanded for this service, and the three great roadmakers who provided the roads were Sir Henry Parnell

[5] Pratt and MacKenzie's *Law of Highways,* 18th ed. (London, 1932), 467.
[6] Robert P. Mahaffey, *Highway and Road-Traffic Law* (London, 1935), 9.

(1776-1842), Thomas Telford (1757-1834), and John Loudon McAdam (1756-1836). The road system of the country had become really modernized in this way when the railways began to be developed, with the result that all the arterial traffic was gradually diverted from the roads.

Decline of the Roads. Between 1825 and 1850, the railways had increased sufficiently to provide an effective arterial grid for travel; the coach services thus became ancillary to the railways and gradually disappeared as the railways developed, so that the main roads ceased to carry any but local traffic. In the last decades of the nineteenth century when pedal cycling became popular, there was, however, a certain revival of life on the old road system.

The Present Road System. With the advent of motor traffic the road system recovered its old importance, and was indeed soon found to be inadequate. The roads at the beginning of the century were administered by nearly two thousand local authorities, without any effective central control. In 1909, a Road Board was constituted to improve facilities for road traffic, and to administer grants from national revenue for improvement of the roads. In 1920, the Road Board was succeeded by the Minister of Transport; and the modernizing of highways for fast mechanical traffic was gradually taken in hand—with the introduction of dual carriageways, roundabout junctions, automatic traffic signals, etc. In 1936, the responsibility for certain "Trunk" roads (4,500 miles in all) was transferred from the local authorities to the Ministry of Transport. These Trunk roads are financed entirely by National Funds, a system which seems likely to be further developed as the national significance of the main road system of the Country is increasingly appreciated.

DEVELOPMENT OF HIGHWAY LAW

Nature of the Highway. Throughout history, the King's Highway "was not a strip of land or any corporeal thing, but a legal and customary right"; it was a perpetual right of passage for the sovereign and his subjects "over another's land." [7] If much frequented, the highway developed into a beaten track; but, even if there were no track at all, the right of way remained.

Definition of Highway. "The term 'highway,' in its widest sense, comprises all portions of land over which every subject of the Crown may lawfully pass." [8] At common law "a highway is a way over which all members of the public are entitled to pass and repass.

[7] Sidney and Beatrice Webb, *op. cit.*, 5.

[8] Pratt and MacKenzie's *Law of Highways*, 1.

... A highway need not necessarily be a carriage way, for footpaths, bridleways and driftways, if open to the public generally, are highways; nor need it necessarily be a thoroughfare."[9]

Ancient Classification of Highways. Sir Edward Coke (1552-1634) recorded an ancient classification of highways: "There be three kinds of wayes whereof you will reade in our ancient bookes. First a footway ... and this was the first way. The second is a footway and horseway. The third ... contains the other two and also a cartway."[10]

"In general, the greater includes the less, i.e. a horseway will include a footpath, and ... a carriage and cart way will, in general, include a way for driving cattle, commonly spoken of as a 'driftway'."[11]

Right of Way. At common law any person may use any highway and any part of any highway for any traffic for which the highway has been dedicated. A highway is not necessarily dedicated for all traffic, e.g., it may not be dedicated for wheeled traffic.

The right of any person in a highway is *to pass along it*—a right of passing and repassing. "A claim to a public right of way may be based either upon dedication and acceptance, or upon some statute."[12] Dedication may be presumed from the fact that the owner has permitted the public to use the way without interference. In modern practice (Rights of Way Act, 1932), uninterrupted use by the public for twenty years in some cases and for forty years in others raises a presumption of dedication.

Rights of way which existed by virtue of some custom are not necessarily highways. For example "the inhabitants of a parish may be entitled by custom to a right of way to the parish church over land lying within the parish:"[13] such rights of way were known as "churchways." The same applies to an old tradition in many parts of the country that where a corpse was carried for burial a right of way was established over the land.

On highways proper, the right of way is absolute. "It is an established maxim—once a highway always a highway; for the public cannot release their rights ... nor is the public right ... lost by disuse."[14]

[9] Halsbury's *Laws of England,* 2nd ed., (London, 1931–), XVI, 181.

[10] Macmillan, Lord, *Local Government and Administration in England and Wales* (London, 1934–), VI, 410-411.

[11] Halsbury's *Laws of England,* XVI, 184.

[12] *ibid.,* 217.

[13] *ibid.,* 202.

[14] Pratt and MacKenzie's *Law of Highways,* 137.

Protection against Robbers. For the protection of travelers it was laid down by the Statute of Winchester, 1285, that "highways leading from one market town to another shall be enlarged where as bushes, woods or dykes be, so that there be neither dyke nor bush whereby a man may lurk to do hurt within 200 feet of the one side and 200 feet of the other side of the way."

Repair and Maintenance. By common law or of common right, the inhabitants of the parish at large are bound to repair the highways. By common law also it is open to anyone to indict at Quarter Sessions or the Assize when any common and ancient King's Highway becomes "ruinous, miry, deep, broken and in great decay, so as to be to the great damage and common nuisance of all liege subjects of our Lord the King."

In the Middle Ages no individual in particular was made responsible for this duty, a weakness which was repaired by an Act of Philip and Mary in 1555, whereby each parish was required to elect yearly two honest persons of the parish to be Surveyors and Orderers of the works for amending the highways in their parish. Statutes of 1691 and 1773 laid down that Surveyors should be nominated by the Justices at special Sessions. The Surveyors were required to prevent "nuisances, encroachments and obstructions" and were authorized to take without payment "refuse or rubbish stones" or other certain material for maintenance of the roads. Justices were at the same time empowered to make Orders to "widen, enlarge, divert or turn the existing roads." [15]

Legal presentment or indictment of a parish as a whole for neglect to maintain its highways was quite common; in the eighteenth century "there were some parishes which had presentments or indictments almost perpetually hanging over their heads." [16]

During the turnpike period most of the main roads were repaired by the local turnpike trustees.[17]

By the Highway Act of 1835, the County and District Councils took in effect the place of the Surveyors and inherited their duties, among which was included an obligation to provide for future as well as present traffic. Despite the Highway Acts, however, "the liability of the parish still remains the underlying principle of the law." [18]

Bridges. At common law nobody is obliged to make a bridge; and common law in this respect was reaffirmed by Magna Carta (1215).

[15] Mahaffey, *op. cit.*, 5-6.
[16] John Shapleigh, *Highways* (1749), 15.
[17] Cf. Macmillan, Lord, *op. cit.*, VI, 348.
[18] Pratt and MacKenzie's *Law of Highways*, 65.

By a statute of Henry VIII, the liability to repair existing bridges of public utility was declared (also in reaffirmation of common law) to fall upon the inhabitants. The duty of repairing bridges includes the duty of rebuilding them when necessary. In later years, certain bodies, e.g., railway and canal companies, have had a statutory duty to provide bridges.

Highway Authorities. The responsible Highway Authorities were successively the medieval manorial court,[19] the Surveyors as representing the Parish, the Justices in Petty Sessions, the County and District Councils, and finally, in certain cases, a department of the Government. The present position is:

	DISTRICT	HIGHWAY AUTHORITY
1. *Trunk Roads (national routes for through traffic)*	Any district	Ministry of Transport
2. *County Roads (all other main roads)*	Urban districts and boroughs	County Council (save that in Urban Districts or Boroughs with more than 20,000 inhabitants, the District or Borough Council can claim the right).
	County boroughs	County Borough Council
	Elsewhere [20]	County Council
3. *Ordinary Highways*	Urban districts	Urban District Council
	Boroughs	Borough Council
	County borough	County Borough Council
	Elsewhere [21]	County Council

Obstruction and Encroachment. "A permanent obstruction erected upon a highway without lawful authority, and which renders the way less commodious than before to the public, is an unlawful act and a public nuisance at common law." [22]

"If a person unlawfully encroaches upon a highway or upon the roadside waste, the district council or highway authority are entitled to abate the encroachment and to recover as special damage, by reason of his unlawful and indictable act, the expenses of so doing from the person guilty of the encroachment." [23]

[19] Cf. Macmillan, Lord, *op. cit.*, VI, 343.

[20] In the County of London there are no County Roads, and the Highway Authorities for ordinary highways are the Metropolitan Borough Councils.

[21] See the preceding footnote.

[22] Pratt and MacKenzie's *Law of Highways,* 107.

[23] *ibid.*, 122.

Extinction of Highway. Despite the common law rule of "once a highway always a highway," machinery is provided for stopping up or diverting a highway. "By an order of quarter sessions made upon a certificate of two justices who have viewed the *locus in quo,* and upon the consents of certain public bodies, a highway may be stopped up, diverted, or turned, either entirely or with the reservation of a bridleway or footway. A proposal to stop up a highway either entirely or partially can only be sanctioned upon proof that the right to be extinguished is 'unnecessary'; and a proposal to divert a highway can only be sanctioned upon proof that the proposed new highway will be either 'nearer' or 'more commodious to the public' than the old one." [24]

Furthermore 'a highway may be extinguished by natural causes, such as inroads of the sea or landslips. If the sea permanently covers the site of the way, the right of passage and the liability to repair are extinguished, and there is no authority for any right to deviate on to the nearest land; but, possibly, in other cases, though the liability to repair is extinguished, the right of passage may remain so far as it is still possible to exercise it, e.g. for foot-passengers." [25]

THE FUTURE

With the advent of motor traffic a new factor has arisen, namely the deplorable casualty toll, which seems likely to alter fundamentally the old ideas of right of way. Whereas from time out of mind the carriageway of the King's Highway was accessible to all road-users, the major traffic arteries of the future will no doubt be one-purpose motorways, from which other road users are excluded. Sir Edward Coke, who flourished at the time when the Pilgrim Fathers set sail from Plymouth, recorded the ancient usage that right of way for wheeled traffic included an equal right for the person on foot; but all this now ceases to hold good. Not only are there motorways, but the one-purpose cycle track is being developed, and segregation of classes of traffic will doubtless increase in order to reduce the danger of accident. The motor vehicle has revolutionized road transport, and the roads are not as they were:

"The old order changeth, yielding place to new."

[24] Halsbury's *Laws of England,* XVI, 265.
[25] *ibid.,* 263.

6 THE INDIAN TRAIL FROM THE TIME OF THE MAYAS TO THE COLONIAL PERIOD

BY HERBERT J. SPINDEN

On Indian records of Mexico, roads are pictured commonly enough by a line of naked footprints, often between parallel lines to indicate that the way is a prepared one. After the coming of the Spaniards we find the prints of horses' feet mingling with those of human burden-bearers. But there are no wagon tracks, for wheeled vehicles were unknown to the American Indian before the coming of the whites. Even after the Spanish Conquest it was a considerable time before carts and carriages came into use outside urban centers in the Latin countries. In nearly all of these the horse and mule took over in partial substitution for the human beast of burden: even royal roads—*caminos reales*—rarely advanced beyond mule trails and in many regions are still such today. Yet Cortés and his soldiers rode horseback up to the Valley of Mexico and entered Tenochtitlan on one of three causeways which reached that Venicelike city over the waters of Lake Texcoco.

As for Peru, the Spaniards were surprised to find well-built roadways, rather narrow, to be sure, since again they were designed for the use of human beings who carried great burdens on their shoulders. Probably the best roads were little used by llamas who could carry no more than a quarter or half a man's load. In mountainous stretches these Inca roads had grades too steep for horse-drawn vehicles. Indeed they sometimes were cut with risers and resembled stairways as much as roadways, except that broad steps were the rule. The European, J. J. von Tschudi, writing in 1842, declares: "There is not in Peru at the present time any modern road in the most remote degree comparable to the Incas' highway."

While that restriction is not true today, the modern engineer is all too likely to make his comparisons in America with ancient Roman military roads of Europe: perhaps if he limited them to European highways at the time of the discovery of America he would be in a better position to understand why easy going in Peru excited wonder in Pizarro's army.

But the sixteenth century in the New World had a background quite different from that in the Old World. In reality the split between two separate evolutionary systems in man's culture dates from the Neolithic Age. It was then the Redman entered America,

without tamed plants, without tamed animals (except his camp-follower, the dog), without metals or complicated machines. That is, he did have small boats, stone axes, and needles, but no application of wheels, even for turning pots; in fact he had no pots and no loom-woven cloth. Essentially, then, we must think of the American Indian as starting from a point close to engineering zero. What he did achieve in the four thousand years, more or less, before the Spaniards came to cut off his unfinished story, represents independent invention from scratch.

The New World was peopled via the Siberia-Alaska portal, the start being made on the Asiatic steppes, more or less in the region of Lake Baikal, with the first halt perhaps on our high plains of North America where buffalo herds guaranteed a good supply of food. Effectively this was great-circle traveling, almost what one gets by stretching a string over the surface of the globe from start to finish. However, we need not think that it shows any sense of shortest distance over a curved surface: rather it was achieved by following mountain ranges as the geological determinants of direction.

Many persons naïvely think of mountain ranges as difficult barriers to travel rather than as aids, which indeed they are, to early man and other nomadic animals. Extensive mountain ranges are the leading highways to be consulted on the primary spread of man beyond his early tropical habitat in the Old World. Heights, I think, were the first highways, not necessarily mountain ranges but ridges between stream heads. Today we lightly assume that the engineer rises supreme to natural obstacles and to simple implications of land form. But does he? As a youth in the West I remember hawk-eyed C. C. Van Arsdale, pathfinder of railroads, bitterly exclaim in Idaho: "The most serious errors in building railroads are made in open country: anyone can handle a canyon!"

Early immigrants to America also found other roads than mountainous ones; and since each touches the problem of roadbuilding for commercial interchange, the carrying on of war, etc., I list them in what seems to be their original order of importance to migrant man.

1. Mountain ranges.
2. Sea coasts as highways.
3. Great river systems.
4. Overland travel in forest, steppe, and desert.

THE GEOGRAPHICAL DETERMINANTS OF MIGRATION

The primary importance of mountain ranges and cordilleras derives partly from the matter of directional control but also from the fact that food, water, and shelter are more dependable there than elsewhere. Trails may lie along mountain flanks before outflowing streams attain such size as to make difficult crossing or, in case of multiple mountain folds in a broad uplift, they may lie preferably in structural groove valleys. In the latter case the location of certain nuclear mountain masses, suggestively called "knots" in the Andes, becomes important. At these strategic points river heads converge and from them ridges diverge; here trails divide and new directions are indicated. Passes have a more obvious importance especially in high latitudes where cold and ice enter into the environmental picture.

Once Bering Strait had been crossed, I think the major route of the Indian immigrants lay along the groove of the Yukon ultimately giving access to the Peace River valley and the Great Plains, but with the Arctic shore as a rival roadway. For the greater part of its length, the Yukon is hemmed in by highlands. The shortest crossing to the eastern flank of the Rockies follows the depression of the Porcupine River, but to hunters slowly on the move some more southerly route via the Pelly or Lewes Rivers might have proved more attractive, especially if it were a favorite route of large migratory game animals. Mountain-and-river spread is seen in the distribution of Athabascan tribes, and seacoast spread in that of the Eskimo.

The first important knot in the Rockies is far inland, in the region of Yellowstone National Park where the Snake, Missouri, Yellowstone, and Green Rivers head. Then, somewhat to the southeast, is the Colorado massif, again a common head of far-wandering streams and an important focus of archeological evidence dealing with early man in America. Our wide Great Basin is rimmed with mountains but flattens at the Mexican border, then reasserts itself as a vast funnel to direct southward moving hordes to the Isthmus of Panama. After this, the Andes lead downward to Cape Horn.

In South America the first highly important mountain knot is found between Popayan and Pasto where the Eastern and Central Andes join. The Eastern Andes range directs traffic across Venezuela and out over the Antilles. The lowest crossing of the Andes, proper, lies near the border of Ecuador and Peru. It lets Amazonian plants spread to the Pacific and also Indians accultured to the Amazon bring their arts of life to wet, western Ecuador and Colombia. Be-

yond this lowest pass, from the Pacific to the elbow of the Marañon, is another highland knot where Amazonian waters run through high parallel valleys separated by ranges. Not until we pass Santiago de Chile does the crest fall below 10,000 feet, although again, in southern Bolivia, there is a headwater separation of Madeira and Paraná tributaries. There are simple proofs concerning the inexorable importance of the cordilleran determinant in the history of the New World. First, we have the fact of the longitudinal spread of Indian languages along this mountain axis. Beginning in the north the Athabascan stock is solid, at first in Alaska and Canada, then it has outlying members, such as the Navajo and Apache, who reach Mexico. Next, the Uto-Aztecan stock also is solid south of Canada but with advancing members who reach Panama overriding, it seems, more ancient peoples. Chibchan languages dominate another long strip from Nicaragua to southern Colombia and after that comes the Quechuan speech which spreads along the vast extent of the Inca Empire. Similarly the Arawak stock swings eastward, mostly over highlands, finally taking to the engulfed Antilles by boat.

In still more important ways the cordilleran highway is the route of trade between the civilized nations of Mexico and Central America and of Peru and Bolivia. This I take up separately under routes of trade. Before leaving the question of the basic mountain road up and down the New World, let me point out that recent Indian occupation along this route raises questions of historical sequence. The Athabascan peoples appear to be newcomers as regards relative order of arrival, with the Uto-Aztecan tribes their most likely predecessors. But perhaps other stocks, now pushed to one side or the other of the Rocky Mountain road also were newcomers in comparison with tribes which reached Central and South America. The Athabascans, it should be noted, broke away to Hudson's Bay and even to the Oregon coast, while the Uto-Aztecan peoples invaded California and Texas to one side or the other of their mountain axis.

The second choice in highways lies along the continental coasts. There boats of some sort become necessary as well as a considerable degree of specialization in food-quest techniques. This is seen at its best in the case of the Eskimo who found economic security by being the first to develop hunting gear with which to take whales and other large sea mammals from shore ice. As a result of this hunting specialization, the Eskimo extended their habitat from southern Alaska and the Aleutians clear around North America to the Gulf of St. Lawrence and to Greenland. But they perfected travel over land as well as over ice, wearing warm, light costumes, quickly building

houses of ice and snow if old permanent lodges were not found in condition for renewed occupancy. The tremendous coastal distribution of the Eskimo validates the basic importance of the coastwise road, at least under living conditions of the far north when secured by the technical specializations already mentioned.

The case of the Caribou Eskimo in theoretical anthropology may be familiar to some readers in connection with the differentiation of the Eskimo from other Indians. It seems that the whaling specialization had to originate either in the North Pacific or in the North Atlantic since the large sea mammals could not cross the entire distance north of either Asia or America. At present an origin in the region of Bering Sea seems more likely, with the Eskimo barely crossing Bering Strait to the eastward from an American focus. The Eskimo, having developed these unique adaptations, spent the force of their migrations by moving on to Greenland and Labrador. In the west they did occupy the Aleutian Islands and parts of southern Alaska. Some whaling appears to have been known southward into California along the Pacific and along the Atlantic as far south as Long Island. There is evidence that an Eskimoid culture retreated from New York and New England before the impact of inland-hunting Indians, who had taken longer to spread overland from Alaska southeastward than the Eskimo had taken by following the much longer seacoast. Recent investigations have emphasized the possibility of Siberian influences in early Eskimo art, perhaps involving iron.

Except for the northern area just considered, coastwise spread is broken by stagnant regions and there is little evidence to support a belief that coastwise spread was consistently important. Along the Pacific south of Alaska there was a development of large canoes for ocean-and-river traffic associated with fishing economy. This extended to northern California, but most of California was a backwater of low-cultured Indians until the counter current of Mexican civilization is met with in Sinaloa.

Likewise on the Atlantic littoral no great use of the sea is in evidence. The Algonkin stock does occupy considerable shore between Labrador and Virginia, but essentially uses an inland-hunting culture; and the western expansion of the stock overland is even more remarkable: to the Rockies in the cases of Cheyenne and Blackfoot and even to the coast of Oregon as regards outlying members of the linguistic group.

Rivers as highways are important in wide continental areas and sometimes, as in the case of the Tupi-Guarani distribution, combine with seacoasts. Perhaps the best examples of this mixed manner of

migration is found in Canada where forest nomads traveled by bark canoe in the summer and by snowshoe, toboggan and dog-drawn sledge in the winter. But the interior Indians of Alaska and Canada did not have the social security of the Eskimo nor make use of all wise adaptations to the Arctic environment. Then longest journeys were done by boat across the network of lakes and streams, although they made the circuit of their traps and fished through the lake ice in winter months. Furs from the Rockies and the Arctic foreshore reached the Hudson Bay and the St. Lawrence by long runs with few portages in early fur trade days. The birchbark canoe type of travel was effective but it did not extend south of the Ohio in the east, nor did it affect to any extent the Missouri and its great tributaries in the west. Indeed on these streams as well as on the lower Mississippi, travel by boat was unimportant among Indian tribes.

River traffic does not come back till we reach the southern parts of Central America where the Sumo and Mosquito tribes exhibit the considerable river skills of South American lowland tribes. While the Orinoco, Amazon, and Paraná Rivers form a vast network of waterways which clearly have played an important role in the dissemination of tribes—witness wide dissemination of language and culture—the use of water roads has led to no outstanding social utility.

Perhaps extensive grasslands and deserts have slowed down human migrations to a greater extent than any other types of natural enviroment but in no case have they proved complete barriers. The most primitive peoples of the New World are precisely the ones that have gone to river-heads and land-ends and generally we may say that they have walked. Barriere in 1743 described certain primitive peoples of French Guiana. He says they would go 100 or 200 leagues just to bring back a hammock or attend a dance, that they walked with great speed and climbed mountains with surprising swiftness, that they carried few impediments, finding their food en route, taking direction from the sun and stars. But they knew the lay of the land!

ROADS AS SOCIAL INSTRUMENTS

The roads that led to Rome also led to Rome's provinces. The road as an instrument of extended commerce, a means of establishing social and religious contacts and of facilitating military coercions, etc., may be studied in all stages of evolution in Indian America. For the lowest orders of society there were recognized routes of travel which differed from the natural highways of primary diffusion in that they were intended definitely for two-way

traffic. Even so, they often rose scarcely above the trails of seasonal migration used by herding animals, which generally could be depended upon to make use of any low pass. The human nomads of forest, steppe, and desert frequently made regular rounds of their habitat, the family and tribal camping sites being visited roughly in a regular succession timed to take advantage of this or that seasonal offering in fishing, hunting, and seed-gathering. Often it was mountain tops in the summer, deep valleys, or the seacoast in the winter. Moreover, by common consent one or more population round-ups were dependable for each year in each geographical area. Invitations of knotted strings, one knot to be untied each day, were sometimes given, they say, to such gatherings, which were festival and ceremonial occasions which might be compared to fairs since barter also took place. Lavish hospitality was the rule. A recent survival, along somewhat different lines, are the potlatch feasts of our Northwest Pacific tribes.

Organized trading parties, especially after the Indians acquired horses, were a possibility even among nomads; but more often we find them undertaken by sedentary Indians who perhaps in their own communities had developed circuit trading on the basis of a five-, seven-, or ten-day market week, and generally with some slight accommodation for visiting merchants.

What many observers fail to recognize is that the more civilized a people become, the more their life and welfare are influenced by other peoples. Actually, advanced peoples need or desire rare materials. They follow up indications of where these may be obtained and find out what would be acceptable in exchange. Or they send out trading parties and, on the basis of information received, even decide to pursue the hard course of employing military inroads for the purpose of demanding tribute in the wanted goods.

The sad relation between trade, tribute, and conquest can be studied at the grass-roots in the case of the Aztec "yaqui" or traveling merchants. These spied out lands, then sought military support for their aggressions. In the case of the white man's traffic with various foreign peoples, students too often accept glosses. They put sanctimonious interpretations on missionary activities which too often have practical aspects. For the relations between Indians and white traders the contrast is still darker. Read Henry's journal of his trading post on the Pembina—the kegs of rum brought over the Grand Portage to Lake Winnipeg, then up the Red River of the North to furnish free drinks before trading begins—you can guess the rest! Then remember that Manhattan gets its liquid name, which means "where they get drunk," because the Dutch had a trading

post near Bowling Green before the official founding of our metropolis.

The clearest evidence of the extent of pre-Columbian trade is archeological on various time levels. It reached its peak during a Toltec florescence of the 12th and 13th centuries when certain special products, such as marcasite mirrors, constructed over a sandstone disk and decorated on the backs with rich designs in lacquer mosaic, were traded from Arizona and New Mexico to Costa Rica, while a self-glazed pottery, made from clay containing lead, occurs much more plentifully over nearly as wide an area. The center of manufacture for the first type of Toltec trade object may have been the northwestern Mexican state of Jalisco, while that of the second product was western Salvador and southern Guatemala.

The trade in gold is also rather clearly documented. The metal entered North America from South America, and a precise advanced technique of lost-wax casting in pseudo filigree runs from the upper Cauca in Colombia to central Mexico. South of this area the lost-wax method of casting of a more solid type extends to Peru along with more primitive hammered work. It seems that both these simpler methods were carried from Venezuela out over the West Indies along with an alloy of gold, copper, and silver.

Among the gold objects found in the sacred Cenote at Chichen Itza, Yucatan, all the cast pieces are from the Isthmian region or from Colombia. The hand of the Maya artist appears in incised designs on gold disks which probably were imported plain from Colombia or Nicaragua. In southern Mexico both Mixtec and Aztec gold work shows indubitable relation to southern art. According to Oviedo, Nicaragua boasted excellent gold workers and was a center of manufacture for objects favored in Mexico.

The same northwest-southeast axis of trade between Mexico and Peru, in general, is indicated by exchange in pearls, jade, and emeralds and by the spread of techniques. Pearls are said to have been taken from the waters about the Pearl Islands in the Bay of Panama, so far as the Mexican and Central American trade is concerned. Elsewhere fresh-water pearls were much sought in the Mississippi Valley while salt-water pearls and pearl shell were sought in California and Venezuela.

Various sources of jadeite and nephrite were exploited in America and the semi-precious stone was carried long distances and also was demanded as tribute from subject peoples. The trade connections are clear enough between Costa Rica, more especially the Nicoya peninsula, and central Mexico and Yucatan. The "Coast of Jade" lay along Vera Cruz, where the Olmeca developed the art

of working it. Whether jade was exported from the Amazon Valley and Venezuela to Central America is still a question.

Emeralds in America are referred by scientists to the Muzo mines in the Chibcha territory of Colombia. There can be no doubt that a few very fine emeralds were possessed by the Aztecs—one being clearly shown and marked in a codex dealing with Indians under the jurisdiction of Cortés. This conqueror boasted several emeralds and pearls upon which he set a great value.

Turquoise was another highly prized material carried great distances. At the coming of the Spaniards most of the turquoise of the Aztecs came from New Mexico. Cabeza de Vaca met a party on the Rio Grande near the mouth of the Conchos which was carrying parrot feathers and copper bells to the Pueblo Indians to exchange for turquoise. The antiquity of this trade is indicated by the occurrence of copper bells and ceremonially buried parrots in considerable numbers at such ruins as Pueblo Bonito and Aztec. The trade goes back to the 12th century.

A further geographical extension of trade is indicated for conch trumpets and gorgets having incised and perforated designs. Shells of the Gulf of Mexico were in use as far away as Canada, especially in the form of showy breastplates. The conch trumpet as a cult object, more especially attached to Quetzalcoatl, the Toltec chieftain who died in 1208, have been excavated in our southern states. At the famous Spiro mound, richly decorated specimens with designs of Mexican derivation recently have been given post-Columbian dates. The stencil technique strikingly developed in the State of Vera Cruz reached around the Gulf of Mexico to Alabama and Georgia. It seems quite probable that the art was distributed in the course of a coastwise trade of Mexican shell for Michigan copper. But the cult of conch-shell trumpets also is documented as far south as southern Peru, along with several techniques, such as negative painting and mosaic decoration in gold, shell, and colored stones.

Precise routes used in ancient times are difficult to determine, although those employed at the time of white contact often can be traced. But the problem of trade really is tied up with other matters: one is the distribution of agriculture, or at least that of special types of agriculture, and special plants with which objects, myths, ceremonies, etc., safely can be linked. Tobacco and the use of pipes, cigarettes, and cigars is an example, or maize and stone metates on which to grind it, or log mortars in which to crush it. But when the regions of America in which such conformities occur are plotted we do find a network of connections. There are some important breaks, more especially over water; for instance, no acceptable proof

has come to light of trade across the Strait of Yucatan from Yucatan to Cuba or across the Strait of Florida between the West Indies and the North American mainland. Obviously the West Indies were reached by boat from South America. The boats used were paddled dug-outs that crept from island to island: there is no evidence of wide crossings of either the Caribbean or the Gulf of Mexico.

Coastwise traffic by canoe flourished along the Caribbean and the Gulf of Mexico in pre-Columbian times as it does today, land roads being of minor importance along the Caribbean coast from Cartagena in Colombia to well up the east coast of Yucatan, and again from the Laguna of Terminos in Campeche to Texas, perhaps even to Louisiana and the Mississippi. We need not suppose that this coastwise traffic was carried on in long single journeys although it seems probable that some trading voyages were extensive. The people of Yucatan used dug-out boats of considerable size and definitely engaged in coastwise trade, but also they made use of overland routes lengthwise of the peninsula as well as across its base.

The first use of the word "Maya" is found in Peter Martyr before Yucatan was discovered. It seems that Columbus, on his Fourth Voyage in 1502, met a large canoe laden with textiles, pottery, etc. off the Bay Islands, obviously engaged in a trading venture. In 1516 these islands were raided from Cuba by a slave-gathering expedition and when, in the following year, Francisco Hernandez de Cordoba tried a second raid he discovered Maya land instead.

GRADED ROADS OF THE MAYA

Trails and roads improved by engineering are found only in the regions of high civilization of the New World, the earliest being seen at cities of the First Empire of the Maya which flourished in the early centuries of the Christian Era. These roads, however, extend for short distances only as parts of city planning. It is not until the Second Empire that we find carefully built roads which extend for considerable distances.

At Uaxactun a graded causeway connects the plazas of Group A on the highest part of the Acropolis and of Group B on a lower lobe: it is some 27 meters wide and has a retaining wall. A narrower paved road runs down the steep ridge toward Groups D and E to the northeast but is lost in low ground. At Yaxchilan sloping roadways, broken by flights of stairs, ascend to hilltops from the valley floor. At Tikal a wide ramp ascends to the level of the Great Plaza and a narrower one crosses the southern ravine, possibly to serve as a dam to retain a reservoir of water. Nakum has a well-marked central avenue as does Ixkun. Quirigua lies on a level river plain consider-

ably aggraded since the time the Maya city was occupied; modern drainage ditches, crossing the flat land between the ceremonial center and the hills, reveal stretches of buried road bed over which the gigantic monoliths may have been dragged. Other great Maya cities of the First Empire, such as Copan, Piedras Negras, and Palenque are picturesque agglomerations of courts and mounds but without special emphasis on ceremonial avenues.

These are much more important at Second Empire sites such as Labna and Chichen Itza and also, it may be added, at Teotihuacan in the Valley of Mexico. At this Toltec capital the Roadway of the Dead is a truly majestic piece of city planning.

The ceremonial road at Chichen Itza, which runs from the central group of Toltec buildings to the Cenote of Sacrifice, has long been famous: it is a well-constructed causeway of rubble and mortar, here and there having vaulted underpasses. Other roads of the same type are found at Chichen Itza and in many Maya cities of northern Yucatan, being called *sacbe* (plural *sacbeob*), "white way." A ruin called Sacbey is described by Stephens. It takes its name from a paved roadway which, the Indians say, runs to Uxmal.

The most remarkable series of carefully laid out roadways lies between Chichen Itza and the east coast of Yucatan, centering in Coba. Although Stephens did not visit Coba, he was told of a causeway. Maler was the first archeologist to reach the site. He photographed one of the buildings, likewise speculating on the roads. Attention was readdressed to these engineering feats by Gann in 1926 and soon after by several other writers. The full statement is Thompson's report on Coba, issued in 1932, and it is amplified in *The Yaxuna-Coba's Causeway* of Alfonso Villa Rojas, in which he describes sixteen different roads. I quote from Thompson as follows: "One of the most striking characteristics of this area is the network of raised, artificial roads connecting the various groups about the lakes, and running off north, east, south and west to other more distant sites. These roads built of stone, raised above natural ground level and for the most part running straight as a die, have been described on several previous occasions. Little need be added here in regard to method of construction. They are all apparently built with vertical sides of roughly dressed stone inside of which is a loose fill of large stone covered over with smaller stone that probably was mixed with mortar and supported a fine plaster surface, now totally weathered away."

Air views taken by the Fairchild Airways Survey for the Museum of the University of Pennsylvania show several roads of this region with the clarity and precision of ruled lines.

These causeways belong to a late period in the pre-Spanish history of Yucatan. Further search probably will reveal roads between the towns lying along the east coast, such as Paalmal, Tulum, etc. I saw parts of road near the northern point of the island of Cozumel, where a broken down viaduct made of great slabs over pillars crosses a flooded area. Farther south at Muyil a brackish lake is tied to an arm of the sea by a canal.

In his *Papeles de Nueva España* the Mexican archeologist and historian, Francisco del Paso y Troncoso, brings together many relations of the 16th century which contain maps drawn in the native manner. These show roads and town squares, irrigation ditches, fortified hills, etc.

But it was a pre-Cortés custom in Mexico to write relations of historical events by picturing them on a general map, showing hills, rivers, and towns in combination with dates. On these maps footprints between place names indicate sequence of events, although in other situations they may be highways. One map-history of this sort is the Codex Xolotl referring more especially to Texcoco. The general map is repeated with fair consistency, while towns, individuals, conferences, battles, funerals, etc. are recorded in pictures to which appropriate dates are attached: this narrative is truly graphic.

Roads pictured on the map-histories of Indian Mexico are still in use and other roads for which we have no documentary history are essentially pre-Spanish. Many trade routes can be followed from ruin to ruin, and indeed we have reference to garrison towns which protected some of the greater trade routes from Mexico to Yucatan to Guatemala, etc. Royal orders came to a Governor of Nicaragua to explore the San Juan river because the gold of Montezuma had been brought north from that region by way of Yucatan. It is a curious fact that Cortés in 1526 led a small army across the base of that peninsula to punish a rebel governor in Trujillo, Honduras. Parts of his route are today all but impassible.

But there were several great trade routes which connected Mexico and the Isthmus of Panama: one led over the open highlands; one threaded the forested lowlands to the east, being the one already mentioned in connection with Cortés; and a third passed along the Pacific coastal plain.

PERUVIAN ROADBUILDING

The roads of the Inca are famous, and doubtless from an engineering point of view deserve the encomiums they have received. Essentially they were a consolidation of military highways but it is

wise to remember two things when discussing them. First, they were footways, for there were no carts or chariots in America. Secondly, they were preceded by a system of paths (for human burden bearers, and for the llama as well) which formed a veritable network across Ecudaor, Peru, and Bolivia, and which reached deeply into Argentina and Chile.

This earlier but extensive network explains continuities and exchanges in the matter of noble Peruvian arts and in the welding of cultures on a time level considerably earlier than the rise of the Inca as military overlords. The situation of Central America is repeated: where out of economic security came primary civilizations, leading to a widespread Pax Americana. Then, out of "have-not psychology," in less favored or more backward regions, came the cult of predatory war and the rise of fighting chieftains in stolen finery.

The early arts of the Andes seem best established over the highlands, with migrations indicated along interandine grooves, before hordes ventured down lateral rivers to the desert coast. At any rate, in all Peru we find in the early archeology evidence of regional individuality joined with other evidence of specimens exchanged in trade and of religious ideas in basic agreement from one province to another. But the great art of Peru is textile art, which derives from three highland animals of the camel family, and the most conspicuous and characteristic food plant is the potato, likewise of highland origin.

Coming to the Incaic time level, best archeological evidence is the Cuzcañan water jar, rather obviously carried as army equipment in long marches across deserts. These jars seem to have been manufactured in or near Cuzco, although some small-scale copying of the form occurs in distant regions. They have been recovered, I believe, from the region of Popayan in Colombia to that of Santiago in central Chile, while the influence of the Inca ceramic styles is obvious in northwestern Argentina.

Discussing the military consolidation of roads under the Inca warlords, Means says: "The two main highways, both of them passing through Cuzco, bound the entire coast and the entire highland zone to the capital. Under Huayna Capac, in whose time the network of footways attained to its fullest development, the highland road followed this route: Pastu–Quitu–Latacunga–Tumipampa–Ayavaca–Huancapampa–Urumachuca–Vilcas–Amancay–Cuzco–Vilcañota Pass–Hatun Colla–Huaqui–Desaguadero Valley–Chuquisaca–Kingdom of Tucma.

"The shore-country road had Tumbey as its northern terminal and ran thence along the coast to Nazca, serving all the great states

of that region. It went through Chumpivilca to Arequipa, Moqueuhua, Tacna, Arica and so down the length of Chile as far as the Maule River."

It seems that Vilcas, the junction point of the two systems, was regarded as the geographical center of the Inca Empire. There were important secondary roads which fed the trunk highways and below those the older network already discussed. It appears that Peruvian roads were more than a commercial and military convenience, they were an institution.

Cieza de Leon who traveled Indian roads from the Gulf of Uruba across Colombia, Ecudaor, and Peru, is one of the clearest commentators on such things as roads and bridges over the entire distance. He notes in one place that the use of lime and mortar was unknown in South America. He describes Inca roads, suspension bridges, etc., in close detail. The road along the coast of Peru, he tells us, was fifteen feet in width, walled on either side, shaded when possible by fruit trees, provided in each valley with rest houses and royal residences, and in sandy deserts between valleys was marked with poles, and at all times and places was kept in good condition. In another place he describes a great suspension bridge over the Apurimac in which the thick cables of rope were anchored in heavy bridgeheads of stone.

Garcilaso de La Vega also describes Inca roads and, indeed, hardly an early writer fails to praise these engineering feats of the Inca. Thus Pedro Pizarro pictures the discomfiture of the Spaniards at the outlet of Lake Titicaca when the natives let go the cables which held in place a pontoon bridge. This bridge was made of rafts and the rafts were made of reeds, but they served the purpose very well, as do reed boats which still ply Lake Titicaca.

Roads in Peru were a social institution. I return to Means: "The chasqui or relay post-runner system of the Incas, together with the system of beacon fires and the roads, road-houses, storehouses, and bridges formed the mechanism of communication which held the Inca Empire together. It was a mechanism which compelled the admiration of all beholders. In adapting it to their own uses the Spaniards did not improve it."

Inca post-runners gave rise to a Spanish postal service, and Inca highways were stretched out till they reached Buenos Aires. Also they aided greatly in the establishment of early missions around Tucuman and Mendoza. Almagro entered Chile over the Inca road of conquest still marked by cairns across the Tarapaca desert. In his *Desert Trails of Atacama,* Bowman writes, "The road through the desert was made possible by the existence of a line of springs

and oases that closely define its course. Traces of the Inca road are still extant. Between Tilomonte and Copiapo, a distance of nearly 300 miles, it is described as running in a straight line and as being a band of cleared earth, about four feet wide and concave in section. On either hand in certain portions of the road are ancient piscas, or stone walls, probably the remains of tamerias or rest huts. On the passes traversed by the road are piles of stone, apachetas, accumulated as the offering of the Indians to the 'guardian of the road,' in much the same way as the Arab adds a stone 'for good luck,' to the piles near the oases."

The archeologists of Argentina and Chile have paid their respects to these ancient roads, and to the forts and rest-houses built along them.

In the *Handbook of the South American Indians* Wendell C. Bennett discusses the engineering achievements of South American Indians paying attention to many other things—to roads, bridges and canals. In eastern Brazil, the Canella and other Timbria tribes, maintained true roads leading out from their villages in four directions, some as much as 23 feet wide and ten and a half miles long. They were used for commerce and for ceremonial races. Other tribes such as the Camayura on the Xingu approach their villages on avenues. On the swamp plain of eastern Bolivia causeways connected the villages and similar works are mentioned on the llanos of Venezuela.

THE ANCIENT RECORD AND THE MODERN PROBLEM

In America trails and trade routes connected town with town and tribe with tribe from the Far North to the Far South. There was interchange more especially in ideas and in precious materials of small bulk. After two thousand years of civilization, nature was still intact and unexhausted. But a sad change took place once Europeans seized jurisdiction. These began to strip America of every kind of transportable wealth and without regard to any far-reaching policy of the public good. Roads, railroads, steamship lines simply became sloughing agencies operating day and night to impoverish America and built up wasteful and spendthrift practices. To be sure, these have since become world practices for all dominant societies of mankind, without engineers and statesmen taking wise precautions in the face of rapidly accelerating destruction.

In an exhibit of the "Opening of the Pacific" at the Century Club in December 1945, I found it easy to demonstrate some effects of these practices in the Pacific Area. What I then wrote concerning water roads applies also, I think, to land roads: "The water roads

of the white man round the world are, first of all, the roads of empire, the means by which the earth has been stripped of many removable forms of natural wealth. Even so the seized and soon exhausted mines and forests, the wild herds on land, the hunted mammals of the sea, supply in their passing but a pittance compared to the continuing worth of tamed crops which almost in their entirety are the unrestricted gifts of humble human societies."

If we take a last look at the problem of roads in ancient and modern America, we find amplification of this interpretation. In the United States of America and in Canada disportation has taken place in about the following order as regards land surfaces (1) pelts and hides of wild animals (2) gold, silver and other metals (3) timber (4) coal and oil (5) wasting of domesticated crops and of the soils which produce them. The roadbuilder has before him, then, a changing problem.

Indian trails served the first white settlers and guided explorers across America. Mackenzie followed an Indian trail to cross the Rockies and reach the Pacific. Thompson, Lewis and Clark, Frémont followed Indian trails. The Hudson Bay Company's system of gathering northern furs was over Indian routes, as was that of the Rocky Mountain beaver men under Ashley and Bridger. The pathfinders of our western railroads followed Indian trails, witness the frank and full accounts of the Stevens Survey in our Northwest.

Practically every state historical society has accumulated data on the importance of Indian roads in the "opening up" of each particular area. The Indian trail became a wagon road, the wagon road a railroad.

The superb paper on "Indian Trails of the Southeast" compiled by William E. Myer, edited and published after his death by John R. Swanton, is fullest for Tennessee but covers in suggestive fashion the entire Southeast, from the Ohio to the Gulf of Mexico and from the Mississippi to the Atlantic seaboard. Here many trails are aboriginal highways which effectively have become national highways. Some, like the great Warriors' Trail, are trunk lines with various branches. Such roads are mentioned in early accounts of the white man's expansion, and likewise are concerned in his efforts to enlist the native tribes in partisan warfare, to further English, French and Spanish designs. The Chesapeake feed line, we are told, was taken by many early white immigrants who began moving from Maryland and Pennsylvania into the newly opened Kentucky and Tennessee regions about 1780. Cumberland Gap was an ancient thoroughfare for the Indian; it became a new gateway for the white man.

The highway of the future—what is it to be, an instrument of

added waste or a road to better understanding? Shall America have new roads for no other purpose than to make new business by attrition, by using up gasoline, wearing out tires by exhausting materials on every hand for an inadequate return in culture, for an inadequate expression of ideals of use and beauty in human society? In ancient America, roads were both utilitarian and esthetic; they still can be, but perhaps it would be wise to redefine utility with an eye to future generations.

7 THE EARLY HIGHWAY IN AMERICA, TO THE COMING OF THE RAILROAD

BY WHEATON J. LANE

When the European colonist came to the New World, he found the land covered by a maze of trails well-trodden by countless generations of red men. Although the early explorers and settlers preferred to travel by water, the narrow path of the Indian often provided the only feasible route. In the northern regions, even large streams were paralleled by trails used in winter or when the current ran swift.

In appearance the Indian trail was a narrow runway a few feet wide, for the savage, animal-like, traveled in single file. Indeed many of the trails had originally been laid out by deer, elk, or buffalo, and were worn a foot or two below the surface.[1] So deeply worn were some that sections can be detected today; but where the depression was slight or, in rocky terrain, nonexistent, it was difficult for the white man to follow. But the sharp-eyed native never had to employ the newcomer's expedient of blazing trees along the path.

The Indian preferred high ground and his trail mounted hills on the long ascending ridges where the snow and leaves were swept from the course. In low country he sacrificed shortness of route in favor of a dry footpath. To the early pioneer, certain of the portage, paths seemed unnecessarily winding. Rivers were usually forded at the junction of some tributary where a sandbar might be found. Bridges were limited to an occasional tree trunk skillfully felled in the right location.

Among the important trails extensively used by the early colonists, mention should be made of the Old Connecticut Path leading from Boston to the upper Hudson Valley near Albany. The Massachusetts General Court established it as a permanent thoroughfare; and two centuries later its general route was followed by the Boston and Albany Railroad. To the west the long Iroquois Trail, originally a war trail, crossed New York through the lands of the Six Nations. Leading up the Mohawk valley, it then cut across the watershed lying south of Lake Ontario and terminated at Niagara River near the Falls.

[1] A. B. Hulbert, *Indian Thoroughfares* (Cleveland, 1902), 16-17. West of the Alleghenies, the buffalo trace was much wider and might be cut as deeply as six feet.

In Pennsylvania the Kittanning Path led from Philadelphia up the Susquehanna and Juniata and over the mountains at Kittanning Gorge to the Allegheny. This became a great trading path. Writing of its western section in the nineteenth century, a local historian declared it "still the same path it was when the last dusky warrior who visited the Juniata Valley turned his face to the west, and traversed it for the last time. True, it is filled up with weeds in summer-time, but the indentations made by the feet of thousands upon thousands of warriors and packhorses which traveled it for an unknown number of years are still plainly visible." [2]

Further south lay Nemacolin's Path, named after a Delaware chieftain. Leading northwest from the upper Potomac, it ended at Pittsburgh. During the French and Indian War it was easily the outstanding route to the Ohio valley. The unfortunate Braddock pursued the general alignment of this trail in hewing out his military road, under the surface of which he was destined to be buried. In the next century the great national Cumberland Road followed this ancient course in part.

In the South, where the Atlantic plain widens, trails usually skirted the upper courses of rivers and, winding westward, afforded access to the interior for explorer and trader. Through the Cumberland Gap ran the famous Warriors' Path which led through Kentucky to the Falls of the Ohio. It was this natural route, seized upon by Daniel Boone and widened into the Wilderness Road, which, with its branches, was to play such a mighty role in the settlement of the Middle West.[3]

West of the Appalachians was a vast network of trails connecting Indian settlements and hunting grounds. Among those employed by the whites were the Great Trail which, as an extension of Nemacolin's Path, followed the north bank of the Ohio to the Beaver where it struck overland to Detroit; the Lake Shore Trail on the southern border of Lake Erie; and the Scioto Trail which, from the Warriors' Path in Kentucky, led through the Scioto and Sandusky valleys to the Great Lakes.

The major Indian trails marked out natural routes of transportation used by highway and railroad. The latter, of course, only followed the general alignment, but the tunnels of eastern railroads often lie immediately under the old trails that climbed the ascending slopes. The colonial highway followed the trail more closely, the "ridge road" becoming an American institution. In many cases the

[2] U. J. Jones, *History of the Early Settlement of the Juniata Valley* (Harrisburg, 1889), 124.

[3] A. B. Hulbert, *The Paths of Inland Commerce* (New Haven, 1921), 19.

early road was a mere widening of the trail with tree trunks left to rot on each side. In places of settlement, where trails converged, they had definite influence in the laying out of streets. The city of Newark, New Jersey, for example, owes the skeleton of its street system, rectangular and diagonal, to the paths which were originally formed by the red man.[4]

As settlements grew in number and private efforts toward road construction were revealed as inadequate, each colony necessarily passed legislation for the development of a highway system capable of affording communication among the towns and of transporting bulky products. The packhorse of the fur trader or frontier settler was obviously a far less efficient carrier than a cart or wagon on the poorest of roads.

Virginia's first road law, in 1632, rather indefinitely left the regulation of highways to the discretion of the Governor and Council, or the commissioners of the county courts, or the parishioners of each parish.[5] But later, jurisdiction was centered on the county courts with the provision that "the course used in England" should be followed.[6] In the mother country by common law it was the duty of each parish to repair the roads, and the Act of 1555 had specified that each parish should yearly elect two Surveyors and Orderers for that purpose. In Virginia, as in other parts of the South where water transportation was near, the early roads led from river landings into the interior. Many of these were appropriately called "rolling roads," over which hogsheads of tobacco were rolled from plantation to shipside.[7] Surveyors were especially directed to establish roads to the church and to the county courthouse.

In New England the General Court of Massachusetts passed a comprehensive act in 1639, ordering each town to appoint two or three men under whose direction highways should be laid out "where they may be most convenient."[8] Rights of way were to be six to ten rods wide in "common grounds." In consequence, roads were built connecting adjacent towns while a coastal highway was opened up terminating on the Merrimac River to the north.

In the middle colonies similar legislation was passed. The more important roads, especially those used for intercolonial travel, were

[4] E. S. Rankin, *Indian Trails and City Streets* (Montclair, 1927), 75 ff.

[5] Hening's *Statutes at Large,* I, 199.

[6] *ibid.,* I, 436.

[7] U. B. Phillips, *A History of Transportation in the Eastern Cotton Belt to 1860* (New York, 1908), 54.

[8] *Records of the Governor and Company of the Massachusetts Bay in New England,* I, 280.

usually placed under the Governor and Council and accorded the name of King's Highway. Occasionally a lottery was held to raise money for straightening roads and constructing bridges. The colonial governor sometimes took a personal interest in improving the highways. Governor William Franklin, for example, interested himself in those crossing New Jersey; in an effort to obtain funds, he wrote the reluctant Assembly that the province would do well to throw off the "Lethargic Stupor" which had "hitherto benumed its best Faculties, and prevented it from improving those Advantages which it has received from God and Nature." [9]

In addition to public efforts toward roadmaking, there were private factors that in certain regions had great influence. Promoters seeking the sale of tracts of land were often obliged to build highways which eventually became part of the public road system. For getting out the timber, long narrow roads starting from waterways were laid out through the forests; subsequently these woodland lanes assisted the process of settlement. The iron industry also led to the building of roads by private enterprise. The Earl of Sterling, interested in exploiting deposits in northern New Jersey, once explained that a considerable capital had been expended there in "creating good carriage roads; but this expense was absolutely necessary" so that supplies could be brought to the works and the iron carried to market.[10]

Most of the colonial roads were unnecessarily long and winding, whether from following Indian trails or from being laid out around farms and lots. Little grading was done and the traveler often found his horse or vehicle mired fast. Washouts occurred after every heavy rain. Surveyors attempted to make some swamps passable by hauling in a few loads of stone or by laying a number of logs crosswise to form a corduroy pavement. Implements for repairing roads were mainly those used by hand, the triangular scraper for leveling being devised in 1769.[11]

The colonists had little conception of fundamental principles of roadbuilding. *The New American Magazine* in 1758 published some observations on the proper construction of roads gained from a Dublin society interested in the advancement of arts and sciences. They consisted of such suggestions as the laying of a stone foundation where the road passed over a soft bottom, and the use of a top layer of gravel which "binds into a strong close surface. The great art of making roads good and lasting, is, to make them close and

[9] *New Jersey Archives*, XVIII, 308-309.
[10] *New York Gazette and the Weekly Mercury*, Sept. 21, 1772.
[11] *New York Journal or General Advertiser*, May 4, 1769.

firm, with an easy fall from the center to the sides, and on each side broad ditches."[12] But the local surveyors or overseers were little inclined to follow these principles. They were generally content to plow up a gutter alongside the road and throw the rich soil into the middle of the carriage track. The farmers and town workers who had been called out for a few days with their shovels and rakes seemed to have no other object than to make each day's labor a short one. Poor traveling conditions gave rise to names such as the common "Featherbed Lane."

Ferries necessarily came into existence as early as roads. Small rivers and creeks were crossed at convenient fording places, and on larger streams an irregular ferry service might be given by Indians with their canoes. But on the principal routes of travel ferries were legally established at an early period. At Boston provision for a grant to the "first ferryman" for transportation across the Charles was made in 1630, the rate being set at a penny per person.[13] At New Amsterdam the Dutch licensed a ferry across the Hudson in 1661; and this Communipaw Ferry was reestablished a few years after the English conquest.[14] Somewhat later, additional ferries ran to Powles Hook (Jersey City) and Hoboken. On the Delaware, service was given between Philadelphia and New Jersey as early as 1688, and for a century early Camden was known as Cooper's Ferry.[15] Throughout the colonial period the number of ferries steadily grew, for bridging wide rivers was too costly. Many types of vessels were employed, depending on length of trip and whether propulsion was by sail, oar, pole, or rope. Maximum rates were set and enforced; and as ferries were considered a "franchise in the Crown," unauthorized operators were quickly prosecuted. Many ferries, being monopolies, were highly profitable to their owners, who often carried on innkeeping at the landings.

Simple types of bridges, such as a log or two placed over a stream, early appeared; but the high cost of vehicular bridges together with the spirit of English common law whereby local inhabitants were obligated to repair but not build bridges militated against more elaborate structures. As in the case of roadbuilding, the county rather than the town organization was gradually forced to take the initiative. Thus the Massachusetts General Court in 1655 directed

[12] *The New American Magazine,* March, 1758.

[13] *Records of the Governor and Company of the Massachusetts Bay in New England,* I, 81.

[14] *Documents relative to the Colonial History of the State of New York,* XIII, 214.

[15] H. M. Cooper, *Historical Sketch of Camden* (Camden, 1909), 14.

the county courts to assess highway bridges on each town,[16] while Pennsylvania in 1700 ordered each county to construct the necessary bridges.[17] In New Jersey either the town or the county bore the expense, or else each paid a certain proportion.

Few large rivers were spanned before the Revolution, although the "Great Bridge" over the Charles at Cambridge was completed in 1663.[18] Stonework was ordinarily too expensive for long structures and most were built of timbers with planks laid as flooring. Drawbridges, or "swinging bridges," were in common use by the eighteenth century. Others were constructed as "tall" bridges so that craft of moderate size could pass unimpeded.

The first American vehicles were crude home-made carts and wagons used on the farm. Constructed entirely of wood and with solid wheels, they were heavy and awkward; but as iron became available and cheaper, they lost their clumsiness and required less draught. Maryland once recognized the connection between iron production and transportation by excusing ironworkers from labor on roads. Imported vehicles, such as coaches, were scarce and were used only by officials or the very wealthy. But chaises and chairs, carrying two passengers, were fairly common by the middle of the eighteenth century. Most of these smaller types were made by local blacksmiths and wheelwrights.

The colonial stage was usually a wagon, for the coach was costly and could accommodate fewer persons. In New Jersey, most traveled of colonies, the early cumbersome wagon evolved into a lighter carriage which, holding twelve passengers and drawn by four horses, attained a fair rate of speed.[19] This type, known as the stage wagon, became widely diffused throughout the northern colonies; it was later used in the South, where stage travel developed slowly because of poor roads. Enthusiastic stage proprietors sometimes called them "Flying Machines." Between New York and Philadelphia they attained a time schedule of a day and a half, undoubtedly the fastest speed obtained anywhere.[20]

Of all the vehicles indigenous to America, the Conestoga wagon was easily the most picturesque. Originating in the Conestoga Valley in Pennsylvania, it first came into historical prominence in

[16] *Records of the Governor and Company of the Massachusetts Bay in New England,* IV, part I, 231.

[17] *The Statutes at Large of Pennsylvania,* II, 68-70.

[18] W. B. Weeden, *Economic and Social History of New England* (Boston, 1891) I, 212.

[19] Seymour Dunbar, *A History of Travel in America* (Indianapolis, 1915), I, 184-185.

[20] *New York Gazette or Weekly Post Boy,* Aug. 26, 1771.

Braddock's ill-fated expedition. With its blue or slate body, red sideboards, and huge white home-spun cover, this wagon appropriately became the national symbol of overland transportation. Its curved bottom kept the load firmly in place, no matter how steep the hill. Later, in the West, an adaptation of the Conestoga was renamed the "prairie schooner." [21]

This widely-used freight carrier was responsible for changing the course of traffic from left to right. The English custom of keeping to the left had first prevailed, and wagons and carriages had been driven from the right side. With the Conestoga wagon, however, the teamster was always at the left—astride the near wheelhorse, walking at the left side, or riding the lazy-board. This was a sliding oak board which could be pulled out between the left wheels and from which the driver could guide the horses and operate the brake. To give the driver a clear view of the road—six horses and wagon stretched out to sixty feet—it was necessary for the wagon to keep to the right.[22] Soon other vehicles adopted the practice, for it was easier to follow the ruts made by the heavy Conestogas than to cross them. The new custom found legal expression; New Jersey, for example, ordered vehicles to keep to the right in 1813.[23]

The first half of the nineteenth century constituted the turnpike era in America. At the turn of the century travel conditions were little improved over those prior to the Revolution, despite the creation of additional postroads and the occasional expenditure of state funds. The need of connecting the growing settlements of the West with the seaboard, the natural increase in trade and travel, and the current turnpike movement in England were all factors creating demands for better roads.

Pennsylvania first took the initiative in 1792 in chartering the Lancaster Turnpike Road Company to improve a route leading west from Philadelphia. The Lancaster Turnpike was the first macadamized road in the United States, being laid with crushed stone topped with gravel.[24] Financially successful, this private enterprise served as an advertisement to the movement. Contemporaneous with the trend toward toll roads was the building of toll bridges by private companies.

[21] For the Conestoga wagon generally, see John Omwake, *Conestoga Six-Horse Bell Teams* (Cincinnati, 1930); and Bryan Hamilton, "The Conestoga Wagon," *Proceedings of the New Jersey Historical Society*, new series, XIV, 405 ff.

[22] Omwake, *op. cit.*, 16; *New York Sun*, Dec. 13, 1933.

[23] *Laws of New Jersey*, 37 Sess., 2 sit., 48.

[24] J. A. Durrenberger, *Turnpikes* (Valdosta, 1931), 51-52.

The turnpike movement was strongest in the northeastern states, but both South and West eagerly accepted the new means of overland transport. New England became literally covered with a network of toll roads; while New York, although primarily interested in the Erie Canal, chartered 500 toll bridge and turnpike companies by 1836. At the same time Pennsylvania authorized 220 companies which actually operated 2,400 miles of improved highway. The ports of New York, Philadelphia, and Baltimore were all bitter rivals for western trade and each threw out turnpikes to attract products to its wharves. In the general enthusiasm, states, counties, and cities subscribed to blocks of stock. Ohio in 1836 authorized the Governor to subscribe an amount equal to that taken by individuals; by mid-century the state owned two million dollars of turnpike securities, many of dubious value.[25]

Although maximum tolls were set by the individual charters, privileges granted were quite favorable. Many companies were enabled to take over and repair existing highways, thus keeping down construction costs. The turnpike era was one of speculative excesses, and it also introduced into American politics the great problem of controlling corporations.

Many advocates of internal improvements looked for support to the Federal government, which had appropriated money for military roads for use against Indians. In 1806 Congress authorized a great national road to connect the Ohio Valley with the seaboard. Its sponsors pointed out that this highway would carry the mail, transmit emigrants to the frontier, and cement the two sections politically; in war, it would be invaluable for the movement of troops and supplies. The Cumberland Road, following the old Indian trail northwest from Cumberland which was connected with Baltimore by a turnpike, was opened to Wheeling in 1818. It was subsequently projected to Illinois. Toll free, it became a great artery of travel and commerce and fulfilled most of the predictions made for it.[26]

The Cumberland Road, together with the report of Albert Gallatin, Secretary of the Treasury, who in 1808 advocated large national expenditures for highways and canals, brought out the question of constitutionality of such procedure. Strict constructionists argued that the Constitution would have to be amended to give Congress

[25] C. E. MacGill, *History of Transportation in the United States before 1860* (Washington, 1917), 124.

[26] For the Cumberland Road, see A. B. Hulbert, *The Cumberland Road* (Cleveland, 1904); T. B. Searight, *The Old Pike* (Uniontown, 1894); and J. S. Young, *A Political and Constitutional Study of the Cumberland Road* (Chicago, 1902).

necessary power. Failure to amend led to a series of presidential vetoes directed against bills for internal improvements. Monroe opposed the establishment of toll gates on the Cumberland Road; and in the early 1830's this thoroughfare, falling into disrepair, was surrendered to the several states and tolls were subsequently charged. The responsibility for building internal improvements was thus necessarily recognized as resting upon the states and their sub-divisions and upon private capital.[27]

A special type of turnpike was the plank road which came into favor at midcentury. The idea of using lumber as surfacing had originated in Russia, and had later diffused to Canada and the United States.[28] Enthusiasts rightly claimed that the smooth wooden surface would markedly quicken the speed of travel. Unfortunately the flooring, half-buried in earth, deteriorated more rapidly than estimated, and high depreciation charges made plank-road companies financial failures. By 1857 their period of popularity had ended, but some prolonged their existence by changing to crushed-stone surfacing.

During the latter half of the century toll roads slowly disappeared from the American scene. Even before the building of canals and railroads, many turnpike companies had failed because receipts did not reach expectations or because of mismanagement. Investments in their securities proved disastrous, both to private capitalists and to those states which had heavily subscribed. Yet too much emphasis has perhaps been given to financial losses. Henry Clay once said, in advocating internal improvements before Congress, "I think it very possible that the capitalist who should invest his money, in one of these objects, might not be reimbursed 3 per cent annually upon it. And yet society, in various forms, might actually reap 15 or 20 per cent. The benefit resulting from a turnpike road, made by private associations, is divided between the capitalist who receives his tolls, the lands through which it passes, and which are augmented in value, and the commodities whose value is enhanced by the diminished expense of transportation."[29] Despite their fairly high tolls, turnpikes cheapened the cost of overland carriage by

[27] Madison, Monroe, and Jackson made effective vetoes of internal improvement legislation, whereas J. Q. Adams approved several measures. Had the ideas of Adams, Clay, and other loose constructionists prevailed, it is probable that the Federal government would have carried out a comprehensive program of highway construction, and might even have built the first railroads. After the surrender of the Cumberland Road, the Federal government was to remain inactive in road construction until the motor vehicle came into use.

[28] George Geddes, *Observations upon Plank Roads* (Syracuse, 1850), 3.

[29] *Annals of Congress*, 15 Cong., 1 Sess., 1377.

nearly fifty per cent.[30] But as railroads expanded their network over the nation, turnpikes succumbed to the more efficient means of transportation. State legislation provided for abandonment, condemnation, or for purchase, at nominal prices, by counties or towns.

The growing emphasis upon railroads found reflection not only in the decline of the turnpike movement but also in general neglect of public roads. Pennsylvania, for example, had early passed appropriations for highways which, built by the state, were later maintained and controlled by local subdivisions. This policy was followed by that of state subscriptions to turnpike companies, and this in turn by financing a state system of canals and railroads. Practically no assistance was given to local governments for roads between 1845 and 1903.[31] Throughout the country a similar neglect prevailed as local governments, with inadequate revenues, found themselves unable to cope with the problem. The fact that long-distance travel now went by steamboat or railroad, and that industries used waterways and railroads exclusively, left the farmer almost the only element interested in better roads. Professor William M. Gillespie of Union College, a leading civil engineer, probably had good reason for stating in 1848 that the common roads of the United States were inferior to those of any other civilized country.[32]

The expansion of the frontier into the lower Missouri Valley and the movement to the Pacific Coast brought into high prominence those trails crossing the mountains and desert of the far West. The Santa Fé Trail, over which the first wagon passed in 1822, and the Oregon Trail, laid out by explorers of the fur trade and from which a long arm extended north of Great Salt Lake to California, were both routes rather than roads. Much of the Oregon Trail, for example, was a zone several miles in width in which wagon tracks crossed and recrossed; in certain places, however, it was narrowed by topography to a single lane.[33]

The gold rush of 1849 marked the beginning of a vast migration to California, some 42,000 proceeding overland that year. First regular transcontinental mail service, however, was instituted in 1858 by a southern route via El Paso and Fort Yuma, the Postmaster

[30] A. T. Hadley, *Railroad Transportation, Its History and Its Laws* (New York, 1886), 26.

[31] W. C. Plummer, *The Road Policy of Pennsylvania* (Philadelphia, 1925), 72-73.

[32] Quoted in William Kingsford, *History, Structure and Statistics of Plank Roads in the United States and Canada* (Philadelphia, 1851), 3.

[33] P. A. Rollins, *The Discovery of the Oregon Trail* (New York, 1935), lxx-lxxi.

General explaining that climatic conditions made that preferable. The Concord coach, vehicle of overland mail, appeared as a rival of the prairie schooner. On the central route, the picturesque Pony Express carried light mail for over a year, until the completion of the telegraph in 1861 brought its services to an end. It remained for the Central and Union Pacific Railroads, joined in 1869, to mark the end of an era. Mail coaches and freighters were diverted to branch lines and to routes opened to new mining camps, but, as in the East, "the railways were following them closely, for a new period of American history had begun." [34]

As the Reverend John Pierpont wrote:

> We hear no more of the clanging hoof,
> And the stage-coach rattling by,
>
> . . . . . .
>
> And the old pike road is left alone,
> And the stagers seek the plow;
> We have circled the earth with an iron rail,
> And the steam-king rules us now.

[34] F. L. Paxson, *The Last American Frontier* (New York, 1910), 191.

8 THE HIGHWAY FROM THE RAILROAD TO THE AUTOMOBILE

BY ALBERT C. ROSE

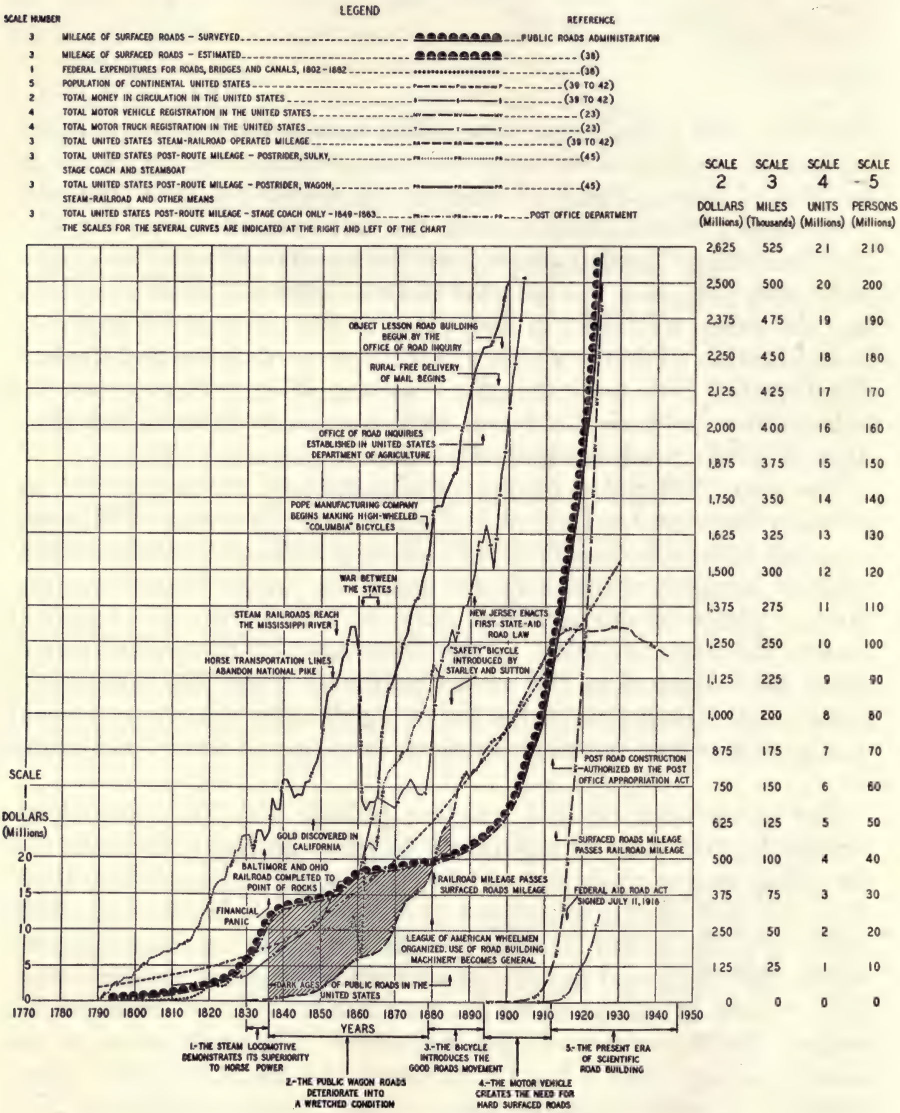
THE year 1830 is the hinge upon which swings the front door opening into the period when steam railroads came into practical use in the United States. The back door of the era hinges upon the year 1893 when J. Frank Duryea made the first successful trial trip of a "gasoline buggy" in this country on the streets of Springfield, Massachusetts (fig. 28). The 63-year interval between these two dates saw the steam railroad win first place as the most useful means of transportation while the wagon roads, because of disuse and neglect, disintegrated into a wretched condition. Within this period the half-century between 1835 and 1885 has been dubbed the Dark Ages of public roads in the United States.

The year 1830 ended nearly a half a century of struggle for supremacy between land routes and waterways. The year 1893 opens a period in which the motor vehicle, the airplane, and the diesel-engined locomotive and ship dominate the scene. Thus the introductory phase of our narrative may be called the age of animal power; the narrative itself as the Dark Ages of the public wagon roads subordinated to the steam railroads; while the concluding remarks are descriptive of the following decades when the internal combustion engine reigns supreme on land, in the water, and in the air.

The narrative is divided into five phases: (a) The steam locomotive demonstrates its superiority to horse power, 1830-1835; (b) the public wagon roads deteriorate into a wretched condition, 1836-1878; (c) the bicycle introduces the Good Roads Movement, 1879-1892; (d) the motor vehicle creates the need for hard-surfaced roads, 1893-1911; and (e) the present era of scientific road building, 1912 to date. It will be noted that the last two phases are extended beyond the 63-year period outlined above. The basic curve on the accompanying chart (fig. 1) indicates the estimated and actual mileages of surfaced public roads in the United States from 1793 to 1925. This curve is presented after many years of search for numerical data with the aid of which a curve might be plotted for the nineteenth century. Failing in this search, a rough curve was drafted with its shape conforming to general economic conditions.

FIGURE 1.–ACCUMULATED TOTAL MILEAGES OF SURFACED ROADS IN THE UNITED STATES–ESTIMATED FROM 1793 TO 1903 AND SURVEYED FROM 1904 TO 1925, INCLUSIVE, AND CURVES OF RELATED DATA

PREPARED BY ALBERT C. ROSE, CHIEF, DIVISION OF VISUAL EDUCATION
PUBLIC ROADS ADMINISTRATION, FEDERAL WORKS AGENCY
WASHINGTON, D.C.– JULY 15, 1946



THE 5 PHASES OF THE NARRATIVE

2. The Wilderness Road, 1774

3. The Whiskey Rebellion, 1794

4. The Lancaster Pike, 1795

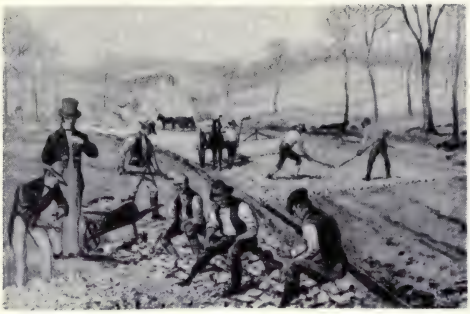
5. Lewis and Clark at Clatsop, 1806

6. The Natchez Trace, 1809

7. Growth of Coastwise Travel, 1814

8. Doctor and Circuit Rider, 1820

9. The Santa Fé Trail, 1822



10. First American Macadam Road, 1823

11. The Erie Canal, 1825

12. The Iron Horse Wins, 1830

13. The Maysville Turnpike, 1830

14. El Camino Real, 1836

15. Our First Iron Bridge, 1839

16. The National Pike, 1840

17. The Oregon Trail, 1843


18. The Plank Road Craze, 1846


19. Dark Ages of the Road, 1850

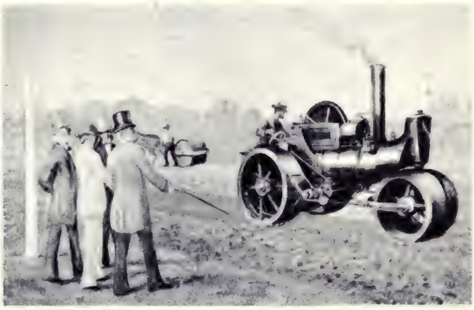

20. Mormon Hand-Car Immigrants, 1856


21. The Camel Express, 1857


22. Blake's Stonecrusher, 1858


23. The Pony Express, 1860


24. The Meeting of the Rails, 1869


25. The Steam Road-Roller, 1869


26. The Chisholm Cattle Trail, 1871


27. Bicycling Days, 1892


28. First American Automobile, 1893


29. The Horseless Carriage, 1900


30. First Transcontinental Auto Trip, 1903


31. The Motor Pathfinders, 1911

32. Beginnings of Highway Research, 1920

This inductive method proved too indefinite until on the same cross-section paper were plotted the actual accumulated total mileages from the year of the first survey in 1904 (29) [1] to 1925, on a vertical scale of one inch being equivalent to 25,000 miles; and the total accumulated expenditures of the Federal government for roads, bridges, and canals for the years 1802 to 1882 (38) on a vertical scale of one inch being equivalent to 5,000,000 dollars. The two plottings were joined by a transition curve between the years 1882 and 1904. Also a transition curve was added to the expenditure curve from 1827 back to 1793, the date when the Lancaster Pike was begun—the first extensive broken-stone road in the United States (fig. 4). These two scales are co-ordinated upon the assumptions that: (a) the cost of surfaced roads to 1882 averaged $2,000 a mile and (b) the total expenditures of the Federal government for roads, bridges, and canals averaged 10 per cent of the total surfaced road expenditures by all agencies. This basic curve of surfaced roads has been checked roughly by Secretary of the Treasury Albert Gallatin's report of 1811 (32), by the annual reports of the Postmaster General showing the mileages of stage routes, by general economic data, and other means. It is offered as an approximate yardstick until some more exact data may be found, if ever. The other curves on the chart bear a direct relation to the basic curve showing the mileage of surfaced roads. The reader is requested to study the chart before proceeding with the narrative.

1. THE STEAM LOCOMOTIVE DEMONSTRATES ITS SUPERIORITY TO HORSE POWER, 1830-1835

Two outstanding events fix the selection of 1830 as the opening of our story. The first was Peter Cooper's demonstration of the practicability of the steam locomotive on the Baltimore and Ohio Railroad in the race with a horse-drawn railroad car (fig. 12). The second was the veto by President Andrew Jackson of the Congressional appropriation to aid the construction of the Maysville Turnpike in Kentucky (fig. 13). This action committed the national government to a policy of refusal of aid for state internal improvements unless they resulted in a national benefit. Although aimed primarily at wagon turnpikes, the veto established the precedent for the railroads to be built later by private corporations.

From this time on, the steam locomotive rapidly forged to the front in the transportation race. The use of steam carriages on public

[1] The numbers in the text refer to the selected references for this chapter, placed at the back of the book.

roads had been tried in England as early as 1784, and by Oliver Evans in Philadelphia, in 1804 (36). The experiments failed largely because the delicate mechanism could not be operated successfully over rough country roads. Thus, the smooth iron track of the railroad became the preferred method of travel. It soon became evident, however, that the capacity of railroad passenger and freight cars could be increased to many times the content of the converted horse-drawn vehicles of the day. Capacity to carry heavy loads at multiplied speed within a few years enabled the railroad to far outdistance its horse-drawn rival system of transportation.

By 1830 our western frontiers had advanced beyond the Mississippi out upon the Indian lands lying east of the Rocky Mountains. The Santa Fé Trail, beginning at Independence, Missouri, had been in use as a covered-wagon trade route to the Mexican Republic since 1822 (fig. 9). An overland route was soon to be opened to the Pacific Northwest into the Oregon country, possession of which was in dispute with England. In the Southwest, El Camino Real extended from St. Louis across Arkansas and Texas, and over the Río Bravo del Norte (Río Grande) to Mexico City (fig. 14).

In the entire United States possessions lying east of the Continental Divide there lived less than 13 million people and nearly 80 per cent of these were east of the Allegheny Mountains. The economy was more than 91 per cent rural. Only 8.4 per cent of the population lived in cities and towns with a population of 2,500 or more (43). No city in the country could boast of tall buildings or a population of a quarter of a million inhabitants. The first eight cities were: New York, 213,470; Philadelphia, 161,412; Baltimore, 80,625; Boston, 61,392; New Orleans, 46,309; Charleston, 30,289; Cincinnati, 24,830; and Washington, 18,827 (44). Graphically the distribution of these centers of population could be represented by a vertical line paralleling the Atlantic Coast and joined to a horizontal line reaching only as far west as Cincinnati.

Our country stood upon the threshold of an industrial revolution which began before the War of 1812 when the embargo acts forced us to establish infant industries to manufacture the commodities formerly imported from England. The main traveled road ran along the Atlantic seaboard and was practically identical with U. S. 1 of today (fig. 7). The principal routes west across the Alleghenies were the Pennsylvania Road (fig. 3) leading to Pittsburgh, Daniel Boone's Wilderness Road to Kentucky, (fig. 2) and the Cumberland Road, or National Pike, which was located as far as Vandalia, Illinois (fig. 16).

The total length of surfaced roads (fig. 1), totaled probably

27,000 miles, consisting principally of turnpikes in the vicinity of the larger settlements. These roads were built by hand labor aided by the ox-drawn plow, a horse scoop for moving earth, a road drag or scraper, the wheelbarrow and other agricultural tools of the period such as the ax, rake, hoe, spade, shovel, and harrow (28). The new type of stone surface advocated by John Loudon McAdam, of England, had been tried experimentally, in 1823, on the 11-mile section of turnpike between Hagerstown and Boonesborough, Maryland, now a portion of U. S. 40 (fig. 10). United States Army engineers adopted the McAdam principles, in 1825, for surfacing the Cumberland Road. At that time stagecoaches made 6 to 8 miles an hour over the best roads and the heavy Conestoga freight wagons averaged 2 to 3 miles an hour. Many of the common roads consisted of widened horse paths with the tree stumps cut as close to the ground as possible. They were muddy in winter and dusty in summer. Across swamps, saplings were laid side by side. This rough road was called corduroy after the *corde du roi,* or king's cord, the ribbed cloth used by French royalty. In the back country, where there were no wagon roads, long files of pack animals loaded with freight were a familiar sight.

To systematize the mounting expenditures for river improvement and the construction of roads and canals, state-controlled engineering organizations had been established in Virginia in 1816, in South Carolina in 1817, and in North Carolina in 1819. These were the parent bodies of the modern state highway departments.

In the cities and towns most of the streets consisted of graded natural soil. Some of the main thoroughfares in the larger centers were paved with waterworn cobblestones, called "pebbles." The first brick pavement in America was built in Philadelphia in 1830 (8), but the work was so unsatisfactory that the pavement was not received with favor. In England Portland cement had been patented in 1824 (21). An Englishman was advocating also a monolithic street pavement consisting of square stones laid on a lime-mortar base (20).

Better streets were needed to care for the growing traffic in the cities. The famous omnibus stagecoaches, in 1830, began to run along Broadway from Bowling Green, in New York City. In 1832 a horse streetcar first rumbled along the tracks on Fourth Avenue, from near the City Hall to Murray Hill where now stands the Grand Central Station. It was a time of expansion and invention. The Hansom cab was patented in 1834 and John H. Cassell received a patent for a bituminous surface corresponding to our present penetration bituminous macadam. In 1835 125 lineal feet of wood block pave-

ment were laid on Broadway from Chambers to Warren Streets. The street improvement in the cities, however, was in sharp contrast to the retrogression of the rural roads. By 1835 railway mileage had grown to 1,098 (31).

2. THE PUBLIC WAGON ROADS DETERIORATE INTO A WRETCHED CONDITION (1836-1878)

The stagecoach and Conestoga wagon traffic began to decline noticeably as early as 1836, a year that saw the Baltimore and Ohio Railroad completed to Point of Rocks, 37¾ miles west of Baltimore. Ever since the turn of the nineteenth century there had been strenuous and often ill-advised efforts to improve transportation by building turnpikes and state-financed canals and railroads. The inevitable result was a money panic, in 1837, brought on by wild speculation and reckless loans made by "pet" banks. Internal improvements were financed by mortgaging the future income of a state. Farseeing leaders saw the need for better administration and design of public roads. Consequently, Kentucky followed the lead of the older states in the East and organized, in 1835, a highway board and engineering force to supervise all state road construction. At this time when manual roadbuilding methods prevailed, the first intimation of an excavating machine came in 1838 when the steam-shovel, patented by William Smith Otis, was used on the Western Railroad of Massachusetts.

Likewise the change from wooden and stone bridges, built by hand labor, came in 1838 when the first cast-iron bridge in the United States was fabricated across Dunlap's Creek, on the National Pike, at Uniontown, Pennsylvania (fig. 15). In 1840, William Howe patented a truss bridge, a generation after Ithiel Town had blazed the way with his truss patented in 1820.

Inventive minds everywhere were devising ways and means to improve the public roads and combat the widespread apathy caused by the popularity of the railroads. In 1846, the first plank road in the United States was opened between Syracuse and Central Square, New York (fig. 18). Many miles of these roads were built during the next decade until the rotting wood proved their inadequacy. Nevertheless, trial-and-error methods of construction were losing ground. In 1847, Squire Whipple of New York contributed his mite to engineering science with the publication of a textbook in which he analyzed bridge-member stresses and proportioned materials according to their tested strength.

The discovery of gold near Sutter's Mill in California, in 1848, began a nationwide trek of fortune hunters to the western El Do-

rado. Gold! gold! became the principal topic of conversation. The controversy in England, in 1850, as to the relative merits of Portland and natural cement received scant attention. By 1852, the railroads had completed a through line from New York to Chicago and two years later the tracks reached the Mississippi River. The gleaming steel rails captured the national imagination (30). Thus the loss was minimized, in 1853, when the stagecoaches ceased running between Frederick and Hagerstown in Maryland, and the 10-ton Conestoga freight wagons drawn by twelve horses went out of business on the National Pike between Baltimore and Wheeling (10).

For nearly a decade until the outbreak of the War Between the States the curve indicating the total mileage of surfaced roads turned sharply upward as may be seen in fig. 1. Power inventions and new devices had a great deal to do with this. In 1856, rock-quarrying was made easier when L. du Pont of Wilmington, Delaware, invented blasting powder. In the following year, while the novel camel express began operations from New Mexico to California to speed news to the gold regions (fig. 21), W. A. Gill of Columbus, Ohio, cleared stumps from a field with the aid of gunpowder, and dump wagons were introduced for road construction. On September 15, 1858, the "Butterfield Overland Mail" set out from St. Louis to San Francisco over the southern route through Arkansas and Texas. In the same year Eli Whitney Blake of Connecticut brought out the jaw rock crusher (fig. 22). The great petroleum industry was born, in 1859, with the sinking of the first well at Oil Creek, Pennsylvania. The Pony Overland Express was racing between St. Joseph, Missouri, and California, in 1860 (fig. 23), as the first gravel turnpike west of the Mississippi River was opened between Prairieville and Paynesville, Missouri (9). When the first shot was fired upon Fort Sumter, in 1861, the "Butterfield Overland Mail" stages were shifted north out of danger of attack from the southern "ox-bow route" to the central overland trail over which ran the Pony Express.

Prior to the outbreak of the War the national government had expended about 14 million dollars in aid to roadbuilding in the several states and territories (26). A large portion of this money was derived from the sale of public lands. East of the Mississippi River an extensive 31,000-mile (39) network of steam railroads overlaid every state. The public wagon roads had reverted from state to local county or township control and were in a wretched state of disrepair and neglect. The wasteful statute-labor system was relied upon for road upkeep (13). The citizens who paid their an-

nual road taxes by three days so-called work upon the roads considered this activity a lark or a picnic. As a result little useful work was performed.

In the East, engineers were debating the relative merits of various types of surfacing. In 1867, the authorities of Central Park, in New York City, expressed preference for the Telford as compared with the McAdam system. They gave gravel first place, however, for their parkways, because of its easy-riding qualities and the simplicity of its maintenance (16, 17). Two years later the first steam road-roller used in the United States was imported from England and tried out in Central Park (fig. 25). News of this important innovation was overshadowed by the fanfare concerning the junction of the Central and Union Pacific railroads at Promontory Point, Utah (fig. 24). The steam road-roller, however, in conjunction with the steam-powered jaw rockcrusher was destined within a few years to bring about a sharp rise in the mileage of surfaced roads (fig. 1)—a trend for the better which has continued down to this day. Until the introduction of Aveling and Porter's steam road-roller, even the use of a horse-drawn roller on macadam roads was considered a luxury reserved for the most important routes. Gravel and broken stone roads were compacted to a large extent by the long-suffering horse traffic.

The tide of interest in roadbuilding was beginning to turn. By 1871, the manufacture of Portland cement was begun in the United States, it having been imported during the past six years. A successful brick street pavement was laid in Charleston, West Virginia in 1873, and plows were pulled on public roads by a steam road-roller. A steam mortar-mixer was introduced in 1877. More important, however, because of its potential effects upon road improvement was the establishment in the same year, by Colonel Albert Pope, of a factory for making the Columbia highwheeled bicycle. Although one year later, in 1878, the steam railroads reigned supreme with 350,000 cars rolling over their tracks, wagon factories had expanded their output tremendously and now there was a total of 15 million carriages, stages, trucks, and carts in operation on public roads and city streets.

3. THE BICYCLE INTRODUCES THE GOOD ROADS MOVEMENT (1879-1892)

The first faint rays of the dawn of a better day for public roads synchronized with the introduction of the incandescent electric light, in 1879, by Thomas Edison. In this year George B. Selden filed application for a basic patent for a gasoline-driven automobile

which would run at a speed of 10 miles an hour. As oil lamps for night bicycling multiplied, two-course concrete pavement was advocated abroad (24). In 1880 began the widespread employment of roadbuilding machinery, including the horse-drawn scraper. The inefficient statute-labor system was generally discredited within the next decade (19).

As more bicycles rolled out over the roads, local organizations of wheelmen were organized to combat the hostility to their use. The local units were consolidated, in 1880, into the League of American Wheelmen to defend the rights of bicyclists and to urge rural road improvement. City streets were in a better condition. In 1881, when the gyratory rockcrusher was patented, there were 229 miles of stoneblock pavement in New York City, 80 miles of cobble, 24½ miles of macadam, and ½ mile of asphalt.

Two years later, when the Northern Pacific, Southern Pacific, and Santa Fé railroads were opened to the Pacific Coast, William H. Diedrick, of Fresno County, California, patented an improved earth-scraper—the parent of the present-day Fresno. A promise of making easier the longer hauls of excavated earth was latent in the patent for the wheel scraper, dated in 1884. These developments were the echoes to the clarion call for good roads which had grown to nationwide proportions, by 1885, as the Rover safety bicycle was introduced to the trade by Starley and Sutton.

4. THE MOTOR VEHICLE CREATES THE NEED FOR HARD-SURFACED ROADS (1893-1911)

As the improved bicycles pedalled into the countryside farther from the cities (fig. 27), bicycle paths were built beside the roads and then the roads themselves were bettered. By 1889, the sand-clay combination of surfacing was attracting widespread interest. Adding clay to a sand road made it passable in dry weather and the proper mixture of sand with a clay soil did away with the mud in wet weather. As the local roads outgrew county boundaries, New Jersey, in 1891, became the first commonwealth to pass a state-aid road law. The first Portland cement concrete pavement in the United States was built, in 1891, on the streets surrounding the Court House in Bellefontaine, Ohio. In this year there was constructed, also, the first brick rural road on the Worcester Pike, in Cuyahoga County, Ohio; Portland cement-grouted macadam was laid in New York State; a Portland cement concrete arch bridge was finished over Pennypack Creek on the Pine Road leading from Philadelphia; the first successful operation of an automobile in the United States was accomplished by J. Frank Duryea on the streets

of Springfield, Massachusetts; Henry Ford produced his first automobile; and the Office of Road Inquiry was established in the United States Department of Agriculture. This last event signified that Uncle Sam had resumed a direct responsibility for road improvement.

By 1896 the lamps of some 4,000,000 bicycles flitted about on the highways at night like lightning bugs. The free delivery of rural mail began in this year to create a demand for better country roads. In 1897 the Federal Office of Road Inquiry initiated the construction of short sections of object-lesson roads throughout the country to demonstrate how good country roads should be built. By 1898 the shearing action of automobile wheels (27), combined with induced air currents and wind, were making roads such a nuisance that Los Angeles County began experimenting with oil as a palliative. In 1900, while motoring was still in its infancy (fig. 29), the Federal Office of Road Inquiry set up its first laboratory for testing road materials. The steam railroads now saw the need for feeder roads connecting the farming areas with their stations. They cooperated with other interested agencies in sponsoring Good Roads trains, staffed with experts from the Office of Road Inquiry, to spread the gospel of Good Roads. As an economical method of maintaining earth roads, D. Ward King reemphasized the utility of the road drag in 1902. One year later, Dr. A. Nelson Jackson in a Winton motorcar made the first transcontinental automobile tour from San Francisco to New York (fig. 30).

In 1904, when the Office of Road Inquiry published the first road mileage survey ever made, France led the world in good roads; in the United States, there existed a total of 153,662 miles of surfaced roads. "Of this mileage, 108,233 miles were surfaced with gravel, 38,622 miles with stone, and 6,810 miles with special materials such as shells, sand-clay, oil and brick, . . ." Thus there was surfaced 7.14 per cent of the aggregate 2,151,570 miles of public roads in the United States (29). The more efficient contract system for building the roads was displacing the wasteful statute-labor methods. Public roads had now won their place in the sun. In the new twentieth century the highway, the railroad, the waterway, and the airway were destined each to serve the public in the sphere in which they were best fitted.

Referring again to fig. 1 it may be observed that the 220,112 total operated mileage of railroads, in 1904, exceeded the 153,662 total mileage of surfaced roads in the United States. It may further be seen that this 30 per cent deficiency of surfaced roads was erased by 1914. From that date on, the surfaced-road curve climbed

abruptly but lagged behind the growing number of motor vehicles which increased from approximately 7 to the mile in 1914 to 38 to the mile in 1925. About 1914, the upward trend of the railroad mileage curve faltered, then flattened out, and since 1930 has wilted like a flower in parched soil.

At the turn of the century the dust nuisance was a serious problem that received the attention of the roadbuilder. During 1905 the Federal Office of Public Roads cooperated with Madison County, Tennessee, in a series of successful experiments to determine the utility of crude Texas oil as a binder for earth and macadam roads. In this year, too, the Rhode Island State Highway Department began experimenting with bituminous concrete as a surface for rural roads. By 1914, when numbers of heavy motor trucks were rolling over the thin macadam roads built for wagons and light automobiles, the dust question had been answered (fig. 31).

5. THE PRESENT ERA OF SCIENTIFIC ROAD BUILDING (1912 TO DATE)

A new question, however, assumed nationwide proportions. What must be done to save the light road surfaces from destruction by the heavy motor trucks traveling between industrial plants and railway depots and seaports to supply the belligerent nations engaged in World War I? The solution of this problem led to the construction of the most extensive countrywide road system ever built by any nation in recorded history (fig. 32).

The construction of roads in the United States by rational technical processes may be considered to have begun in 1912 with the passage of the Post Office Appropriation Act carrying an appropriation of $500,000 for post roads. The Office of Public Roads began in that year tests on experimental roads in Maryland and Virginia. In 1913, the first post road was built under that Act in Alabama. Then on July 11, 1916, President Wilson signed the Federal Aid Road Act. This act, a truly important landmark in the history of American transportation, proved to be the parent legislation pledging national aid to the construction of the 1,384,000 miles of surfaced rural roads completed in the quarter-century between World War I and America's entrance into World War II.

9 HISTORY OF THE MODERN HIGHWAY IN THE UNITED STATES

BY SPENCER MILLER, JR.

INTRODUCTION

The modern highway system in the United States was not projected or fully developed at one time but was rather evolved over a longer period to meet a gradually expanding need for more adequate motor transportation. The highways of today represent in many cases the adaptation of earlier roads laid out in the horse and buggy days prior to the coming of the automobiles. Over the years the alignment of roads have tended to permanence; the location of some of our earlier post roads and turnpikes provided the alignment for some of our present highways.

But what has changed the character of the design and construction of the modern highway has been the growing recognition by the highway engineer of the transportation revolution wrought by the coming of the automobile and the necessity of designing functional highways to meet the requirements of the motor age rather than attempting to adapt old land service roads to modern high speed traffic. The extent of that revolutionary change can be measured by the fact that since 1920 population has increased in the United States by 27 per cent, but automobile registration has increased 370 per cent. In the last two decades motor traffic has increased six fold and automobile mileage ten fold. Today the entire population of America could be transported by motor car. We have literally become a nation on wheels.

The coming of the motor car, moreover, has done more to change the pattern of communal living in the past quarter century than any other factor. Today 50 per cent of the communities of the nation depend entirely upon highways and motor transportation for commercial intercourse with their neighboring communities.

At first the highway engineer attempted to meet this transportation revolution simply by super-imposing the new automobile on the old street system. The failure of that method to solve our traffic problem became increasingly evident as the grid pattern of the older city streets with unlimited access, with streets crossing at grade, made every street a through one and every corner a source of traffic delay and potential accident. The installation of traffic lights,

while reducing traffic accidents at intersections, has also reduced traffic flows and inevitably reduced the lane capacity.

The recognition of the futility of this method resulted in the new functional approach to highway design and construction. That change in approach may be said to have begun early in the 1920's with the idea of the limited access highway. It represented the application to highways of the idea of limited access as developed by high-speed railroad transportation and is but another example of the interaction between the railroad and the newer form of motor transportation.

There are a series of milestones in the history of the American highway which record changes first in attitude and then in design. The first milestone came at the end of the 18th century with the surfacing of the Philadelphia and Lancaster Turnpike with broken stone, the first road in the country to be surfaced. This was followed in 1806 by Congressional authorization of the National Road for which a total of nearly $7,000,000 was appropriated between that year and 1838; and by some short-lived state highway activities in such states as Virginia and Kentucky, during that period.

The second significant event in the annals of road construction was the invention in 1858 of the stone crusher by Eli Whitney Blake of New Haven, which made possible the design and economical construction of highways on a large scale.

The third milestone came after the advent of the rubber-tired bicycle, about 1870. The League of American Wheelmen, organized in 1880, conducted an extensive educational campaign for hard surface roads which resulted in a definite movement for improvement both in the East and Middle West. This soon resulted in legislation for state-aid to counties and in turn led to the Federal interest in legislation for road improvement.

In the more urban communities, block, brick, and asphalt pavements had gradually come into use. The extension of hard surface roads to the rural areas was still to be accomplished. Among the pioneers in this extension and improvement of rural roads in the East was Essex County, New Jersey, which raised the needed funds through a bond issue authorized by a special act of the legislature of the state.

The fourth and most important milestone came soon after the beginning of the 20th century, with the development, growth, and extended use of the automobile. This soon resulted in the establishment of state highway systems throughout the country and in Federal aid to such highways. The story of the progress and revolutionary advancement that followed, as well as the physical growth

and economic importance of the modern highway, is the burden of this essay.

1. STATE AND FEDERAL GOVERNMENTS AND THE DEVELOPMENT OF THE MODERN HIGHWAY

The State of New Jersey early took the lead in highway legislation by passing in 1889 a general county road law permitting counties to issue bonds for the construction of broken stone roads and authorizing the assessment of one-third of the cost of the improvement upon abutting property owners. In 1891 and 1892 New Jersey passed acts providing state aid for road construction to counties, and in the latter year it paid to Middlesex County in the center of the State the sum of $20,662 to help construct 10.55 miles of broken stone roads from New Brunswick to Plainfield. The State Board of Agriculture was originally in charge of this aid, but in 1894 the office of State Commissioner of Public Roads was created in New Jersey.

Massachusetts, Vermont, California, Connecticut, Maryland, and New York followed the similar action in rapid succession. Others gradually joined the procession until all 48 states had adopted a state aid program for highway construction by 1917; by 1921 every state had established a State Highway System.

In the early decades of the 20th century experimentation both in the design and construction of highways and in testing of materials centered in the several states; such progress as was made was by the states and local units of government. This conformed to the historic pattern of our American Commonwealth in which our states are in reality forty-eight governmental "laboratories."

The Federal government which in the early days of the Nation exhibited an interest in roads abandoned this area of interest for two generations from 1838 to 1893. In the closing decade of the last century this interest was renewed in the development of the highway system of the country, at the instigation of "The League of American Wheelmen." On March 3, 1893, Congress established the United States Office of Road Inquiry and made an appropriation of $10,000 for the purpose of carrying on research and educational work in connection with road management and construction. The office was authorized to prepare and issue publications and to assist agricultural colleges and experiment stations in road matters.

From 1893 onward the Federal government played an increasingly important role in the development of the highway and transportation systems. First by general investigation, then by research, it helped to shape the highway laws and policies in the country, and finally it climaxed this activity by providing substantial Federal

contributions to highway construction. While Federal grants-in-aid did not come into effect until July 11, 1916, they were foreshadowed as farmers discovered that good roads were essential in moving the produce of their farms to market.

Bills were introduced in Congress from time to time after 1903 on this subject. About 60 bills calling for Federal aid were introduced in the year 1912 alone and the modest sum of $500,000 was voted for highway construction as part of the Post Office Appropriation Act. This money was limited to such states and local subdivisions as were willing to pay two-thirds of the cost, in which case the Federal funds covered the other one-third. Under this act, of which seventeen states took advantage, 425 miles of roads were improved.

A joint Congressional Committee was also appointed to study the problem of more extensive Federal aid for highway construction; it made its report in 1915, which resulted in the Federal Aid Road Act of 1916. The report emphasized that Federal aid to roads would accomplish some of the objectives sought by the framers of the Constitution, namely: establish post roads, regulate commerce, provide for the common defense, and, above all, "promote the general welfare."

The 1916 Act, moreover, appropriated $75,000,000 to be spent over a five-year period by a definite formula; one of its most important provisions called for funds to be distributed only to states having state highway departments, which were designated as the proper agencies for receipt and expenditure of these funds. By that time 42 out of 48 states had such departments; the remaining six organized before 1920. The Office of Road Inquiry of 1893, known as the Office of Public Roads from 1905 to 1915, was now renamed the Office of Public Roads and Rural Engineering and designated as the agency to supervise the expenditure of these Federal aid funds. The act also imposed upon the states the duty of the permanent maintenance of highways which had been sadly neglected in some.

In 1918 this agency was renamed the Bureau of Public Roads. Thomas H. MacDonald became its head and has continued in that capacity ever since. In 1921 by a supplemental act, there was established the Federal Aid System which consisted of 7% of the total rural road mileage then existing in the respective states. This system covers the main routes of the several states.

Later, in 1936, in addition to the above system, the Federal Aid Secondary System was authorized to consist of secondary or feeder roads including farm-to-market roads, rural free delivery mail routes and public school bus routes. For both systems, the Federal gov-

ernment will share the cost of construction where the work is approved by the Bureau of Public Roads.

The Bureau of Public Roads, transferred in 1939 from the Department of Agriculture to the newly established Federal Works Agency, was renamed the Public Roads Administration, and continued to administer the Federal Aid funds. In 1949 it resumed its former name as a part of the Department of Commerce.

Between 1916 and 1943 the total Federal appropriations in regular Federal aid, emergency grants, and grants for grade crossing eliminations totaled over $3,000,000,000. In addition to this many more billions were provided by the states and their local subdivisions.

The Federal Aid Highway Act of 1944 marks the pattern for comprehensive improvements for the next twenty-odd years. It assigned specific grants for aid to construction on the Federal Aid System in rural and urban areas and for the Federal Aid Secondary System. This Act authorized Federal contributions of $500,000,000 in each of the first three post war years. In 1948 this Act was extended for a period of two years but the total appropriation was reduced to $450,000,000 a year.

In the Act of 1944 a National System of Interstate Highways was authorized not to exceed 40,000 miles in extent, that it is to connect the principal metropolitan and industrial areas, on a regional basis and incorporating therein the main routes of strategic importance for national defense.

Up to the end of 1949, there was selected and approved for inclusion in the National System of Interstate Highways a total of 37,681 miles, of which 34,799 miles are rural roads and 2,882 miles are urban. The remaining 2,319 miles are tentatively reserved for by-passes around cities and additional urban routes.

The effects of Federal participation in highway dvelopment have been far reaching. The activities of the Bureau of Public Roads set up by these acts, the growth and operations of the 48 state highway departments, the vast increase in automobile use and motor transportation, all parallel each other and are interrelated with modern highway development in this country. The following are the principal results of these related activities:

(a) Provision of funds required for the development, construction and systematic maintenance of highways, with the gradual and very welcome elimination of "political roads" and "pork barrel" spending;

(b) Establishment of well organized highway departments and state highway systems in all of the states and territories, the stimula-

tion of appropriation of funds for roads in the states and their subdivisions, and the construction and improvement of many hundreds of thousands of highways and roads throughout the country;

(c) Advancement of scientific highway research and the coordination of standards of highway improvements with the changing and growing requirements of traffic;

(d) Adoption of uniform plans, specifications, bidding forms, reports, and the better supervision and control of location, design, and construction;

(e) Extension and development of more adequate highway services including maintenance and operations incidental thereto such as snow removal and ice control, lighting and safety operations, uniform signs and signals, and highway roadside development and control;

(f) Establishment since 1934 of the system of highway planning studies in collaboration with the states which includes:

1. Traffic Surveys
2. Financial Surveys
3. Road Use Surveys
4. Road Life Studies

Such data are used in facilitating more efficient long-range planning and programming, and in coordinating highway improvements, design, and construction with present and future needs and economic justification;

(g) Provision of the principal stimulus for highway expansion and development on an economic and scientific basis, and the advancement of sound engineering research and principles as a basis for highway design and construction.

The Bureau of Public Roads, as it is now known, working with and through the 48 state highway departments, constitutes the backbone of modern highway development. The American Association of State Highway Officials composed of the several states and territories and Bureau of Public Roads organized in 1914, with the various regional associations, is one of the principal cooperating organizations; the Highway Research Board of the National Research Council, established in 1920, is the other principal cooperating agency. The work of these two organizations has been invaluable in the research and scientific operations carried on in connection with modern highway engineering problems. Among the 37 member organizations of the Highway Research Board are the American Road Builders Association, the American Society of Civil Engineers, the

Corps of Engineers of the U. S. Army, and the Bureau of Yards and Docks of the U. S. Navy.

2. PUBLIC AND PRIVATE STIMULUS FOR MODERN HIGHWAY EXPANSION

The immense and continuous growth of the number of motor vehicles in use on American roads since 1900, the increase in speed and weight of these vehicles, and the still greater increase in road mileage traveled annually have been in themselves potent stimuli for the extension of the highway systems in the country.

During the second decade of this century a number of groups of highway enthusiasts promoted several long, even transcontinental routes, all making for a national highway system. Among these sponsored routes were the Dixie Highway, running from Miami to Chicago; the Jefferson Highway, running from Winnipeg to New Orleans; the Park-to-Park Highway, connecting Glacier, Yellowstone, and Yosemite National Parks; the Yellowstone Highway, running from Plymouth Rock to Puget Sound; the William Penn Highway, across the State of Pennsylvania; the Santa Fe Trail; the Columbia River Highway; and the Border Highway. Most of these are now in the United States Numbered System or in the Federal Aid System, although they do not appear to have any official Congressional recognition as far as their names are concerned. They are used extensively by tourists and pleasure drivers and pass through the most beautiful scenic sections of the country. The Blue Star Memorial Highway, recently sponsored by the National Council of State Garden Clubs as a tribute to the men and women of the armed forces of World War I, follows existing U.S. Numbered Highways on the interregional system and was given official recognition by the legislatures in many of the states.

The most noted of these long routes is the transcontinental highway known far and wide as the Lincoln Highway. The first of the sponsored highways, it is the principal transcontinental route leading from the Atlantic to the Pacific. It was started by the Lincoln Highway Association in 1913 and extended originally for a distance of 3,389 miles, later shortened by relocations and improvements. The Association was successful in getting public and private appropriations over the years so that over $150,000,000 was actually spent in its improvement before the World War II. The Lincoln Highway Association and similar organizations have been leading influences in highway progress and in the development of the transcontinental systems.

The private associations of the automotive industry, construction

and trade associations such as the American Road Builders Association, Association of General Contractors, Automotive Foundation, American Automotive Association and the Portland Cement Association, and associations of highway users and motorists have exerted substantial influence in the advancement of this country's highway system. Demands of individual highway users, farmers, townspeople, industrialists, and other groups, whose interests sometimes conflicted, have nevertheless greatly stimulated highway improvement.

3. TYPES AND NUMBER OF VEHICLES, SPEED, WEIGHTS, AND VOLUME OF TRAFFIC

For 4,000 years the speed of traffic on roads or highways had hardly varied. Abraham of the Old Testament could travel as fast as could George Washington in 1775. Even with the coming of the automobile, traffic speeds on highways increased but slowly for some time. When Roy D. Chapin drove his Oldsmobile from Detroit to New York in seven and one-half days in 1901 he barely exceeded the speed of stagecoaches. A transcontinental trip from New York to San Francisco made by three different types of automobiles in 1903 took 74 days, not as fast as the old Pony Express; but since then speeds have increased rapidly and are now limited largely by law. The first law regulating the speed of automobiles was passed in Connecticut in 1901 providing for "12 miles per hour and 8 miles per hour in cities." Gradually speeds have increased in all the states.

Some states still have speed limits not exceeding 40 miles per hour on major highways; but higher speeds are in effect in most states. Except for Connecticut, Maine, and New Jersey, no state has a 40 mile limit on rural roads. The Merritt Parkway in Connecticut permits a speed of 55 miles per hour over a major portion of its length, while the Pennsylvania Turnpike between Harrisburg and Pittsburgh allows 70 miles. Actually, still faster speeds are reached.

Weights of vehicles have also increased considerably since freight-carrying trucks were introduced in 1904. Both speed and weight have an effect on the type of highway needed, and are among the factors that made it necessary to develop higher types and standards of American highways.

From 1895 to 1904 the number of automobiles in the U. S. increased from four experimental cars to 55,290 in actual use—including 700 trucks. The rate of increase of both passenger automobiles and trucks from that time on was enormous. By 1910 there were in use 468,500 registered motor vehicles of which 10,123 were motor trucks. By 1920 there were 9,239,161 registered motor vehicles of

which 1,107,639 were trucks and buses. By 1930 there were 26,-531,999 registered motor vehicles including 3,559,254 trucks and buses.[1] By 1941, before the day of Pearl Harbor, there were 34,-472,000 registered motor vehicles, of which 4,948,044 were trucks and buses.[2] To these figures should be added publicly owned non-registered vehicles which now total about 550,000.[3] These figures dropped slightly through the war years. The 1948 total motor vehicle registration was 41,151,326 vehicles of which 7,227,380 were trucks. By 1949 there were over 43,000,000 registered motor vehicles on the road. By 1916 horse-drawn vehicles had practically disappeared from cities. Excepting on farms and in farm areas, few horse-drawn vehicles are in practical use at this time, even on rural roads.

The volume of traffic increased even faster than the number of vehicles. The average number of annual road miles per vehicle had grown from 5,000 in 1920 to 9,700 in 1948. The total distance traveled in 1948 in the entire country, including traffic in cities, was estimated at 397,589,000,000 vehicle-miles. Of these, 198,507,000,000 miles or about one-half was on rural highways outside of cities. One per cent of this total was bus traffic; 18% was by truck and all types of freight-carrying vehicles; and 81% is credited to passenger car traffic. In 1909, peak year of horse traffic, some 26,000,000 horses and mules traveled 13,000,000,000 miles.

It is estimated that in 1940 a total of 565 billion passenger-miles were driven by motor vehicles over all roads and streets in the country. This constituted 90.7 per cent of all passenger traffic by all types of facilities. Of this 90.7 per cent, 86.2 per cent of the passenger-miles was by private passenger cars and 4.5 per cent in commercial buses. All other means of transportation accounted for only 9.3 per cent passenger-miles, which included airways 0.4 per cent, waterways 0.5 per cent, and railroads 8.4 per cent.

It is further estimated that during the year 1940 trucks carried a total of more than 57 billion ton-miles,[4] traveling about 30 billion vehicle-miles. In that same year the railroads are reported to have

[1] There were registered during 1930 only 40,507 buses, but with non-registered publicly-owned buses, the total was about 100,000.

[2] There were registered during 1941 only 88,800 buses, but with non-registered publicly-owned buses, the total was about 150,000.

[3] During 1947 truck registration increased to about 6,500,000, or about ⅓ higher than in 1941.

[4] In 1946 trucks carried a total of about 73½ billion ton-miles and in 1947 carried 89 billion ton-miles, or 21% more than in the previous year. By 1949 the number of ton-miles carried by trucks approximated one-hundred billion.

approximately 375 billion revenue ton-miles. Practically all farm products are carried by trucks either direct to market or to the nearest railroad terminal, and 56 per cent of all livestock received at all stockyards was hauled by truck in 1942. A substantial percentage of the products of mines, forests, and factories is carried over the highways of the nation by heavy trucks from place of origin to consumer or to the railroads. For trips of less than 200 miles in industrialized areas it is usually more efficient and cheap to ship by truck than by railroad.

The primary state highways, totaling 349,929 miles or slightly more than 11 per cent of the total rural road mileage in the country, carry more than 74 per cent of the total rural traffic. About 83.1 per cent of all the rural highways carry daily averages of less than 100 vehicles per day; 11.4 per cent carry between 100 and 500 vehicles per day. Only 5.5 per cent of all the rural highways in the country carry 500 vehicles per day or over, of which percentage slightly less than half still carry 1,000 vehicles per day or over.

It is this 2.7 per cent of the highways, carrying the greatest volume of traffic, that absorbs the largest percentage of the funds spent on highway construction and that constitutes the principal highway problem of the present decade. While only about 1/10 of 1 per cent of all the rural highways carry an average daily number of vehicles in excess of 5,000 per day, some state highways carry much heavier traffic. The traffic on the state highway system of New Jersey in 1949 for example averaged more than 7,500 vehicle miles per day for each mile. Some of the most congested metropolitan areas are faced with the problem of providing capacities for average daily traffic on the more heavily traveled routes in excess of 50 thousand vehicles, and for peak daily traffic in excess of 100 thousand vehicles.

These figures indicate some of the problems that had to be solved in the past two decades, in the planning and designing of modern highways in the metropolitan areas in the vicinity of New York, including the states of New Jersey and Connecticut, and in similar areas in and around Philadelphia, Chicago, Detroit, Los Angeles, San Francisco, and other large cities.

4. ROAD SYSTEMS AND METHODS OF FINANCING AND CONTROL

Prior to 1891, practically all rural roads were under the control of local officials, with but few notable exceptions, such as the National Road and some highways in Virginia and Kentucky built in the early half of the century and operated as state highways for a short

period. The legislatures of the several states chartered turnpike companies and controlled matters relating to them, but there were in general no state systems of roads and ordinarily no state jurisdiction over construction and maintenance.

Since 1891, most city streets and, in the greater number of states, most rural roads of secondary traffic importance are still under local control. These roads are mostly financed by local taxation or special assessments on adjacent real estate, and are generally controlled by township or municipal officials. In some states, the counties give varying degrees of financial aid and share to some extent in the supervision and control of these local roads. Since the beginning of the century there has been an increasing tendency in that direction, with complete state control in only four of the states.

More important rural roads, extending across township lines, and through-traffic streets through cities generally constitute the county road systems. These are often financed jointly by the State, county, and municipality. The control of these country roads is mostly by county authorities, with state supervision in many cases where state aid is involved. The funds for such roads are derived from local assessments, bond issues, and from such sources as are open to the states.

The state systems generally include most of the main highways and heavily traveled roads across the counties, across the states, and the portions of the transcontinental or national highways within the respective state limits. These include practically all the primary Federal Aid System and the U.S. Numbered Highways.

In the earlier years the state highways extended only between cities, generally stopping at the city line. Federal aid under the 1916 act could not be given to highways within cities having a population of 2500 or over. This and other restrictions have been removed and Federal Aid highways may now run continuously through the cities and do so in many states.

State highways are generally financed by state highway-user's taxes, such as registration fees and licenses and gasoline taxes; by federal contributions; bond issues; tolls; general revenue and property taxes, and other miscellaneous incomes. These state highway systems are controlled directly by the highway departments of the respective states; indirectly the portions in the Federal Aid System are also controlled to some extent by the Bureau of Public Roads.

By 1947 there were four states in which the state highway departments had full control of virtually all the rural highways. These are: Delaware, controlling 3856 miles out of a total of 4284 miles of streets and highways in the state; North Carolina, controlling

62,234 miles out of a total of 67,335 miles of streets and highways in the state; Virginia, controlling 47,164 miles out of a total of 52,317 miles of street and highways in the state; West Virginia, controlling 33,234 miles out of a total of 36,334 miles of streets and highways in the state.

A recent report made by a "Public Administration Service" for Kentucky proposed that that state also take over control of its rural roads. In other states, the state highway departments control varying percentages of rural highways, in addition to the state systems. Most states have county highway departments and some also have township organizations controlling rural highways, in addition to the operation of city streets by municipal authorities.

Some of the state highway departments have been controlled from the beginning by a single executive; a director, commissioner, or engineer. Others have been and still are controlled by a commission or board of three or more men. In some states, single executives have given way to commissions, and in others the reverse has been true. In recent years the trend has been toward the single executive. In some cases, the Highway Department is directed by an engineer, as a division in a Department of Public Works. In others it is set up as a functional unit of government under an administrator. In all cases, the planning and engineering are directed by a chief engineer with more or less adequate engineering staffs.

Of the total of 3,313,000 miles of existing rural roads and city streets in this country, about 304,000 are city streets. In 1946 there were about 342,071 miles of highways in the primary state highway systems in the country, and a total of 580,078 miles of highways under state control. Of this total, about 485,552 miles were surfaced. Of the entire system of 3,313,000 miles only about 52 percent was surfaced by the beginning of 1947, and only a small part of that had higher type pavements, such as Portland cement concrete, asphalt, brick, etc. Of the mileage in the state highway systems, about 231,922, exclusive of Hawaii and Puerto Rico, are in the so-called 7% Federal Aid System. The network of U.S. Numbered Highways which are generally included in the Federal Aid System consists of about 156,000 miles.

These U. S. Numbered Highways are not laid out or constructed by the Federal government. They are in general parts of the state highway systems. Only highways within Federal areas, National Parks, National Forests, etc., are constructed and maintained entirely by the Federal government.

Highway-user revenue, as a source of highway funds, had its beginning at the turn of the century. New York was the first state

to levy a registration fee on automobiles in 1901, while Oregon was the first to levy a motor fuel tax in 1919. Both of these types of taxes, and a motor carrier tax subsequently added, have since been adopted by all the states. Up to 1913 inclusive, the total available funds for highway use from all sources were $187,638,000. During 1914 the amount available had risen to $75,000,000 for one year. By 1920, the annual funds, including Federal aid, had increased to $320,507,000. By 1941 the income available for state use for highways totaled slightly over $1,650,000,000 during the one year, as indicated in the following table, including the 48 states and the District of Columbia:

Balance available January 1, 1941	$413,998,000
Receipts:	
Highway-User Revenue	833,289,000
Tolls	16,954,000
Property Tax & General Revenue	4,122,000
Miscellaneous Income	15,739,000
Federal Funds	158,526,000
Transfers	7,612,000
Sale of Bonds	199,857,000
Total Funds available during 1941	$1,650,097,000

The Bureau of Public Roads reports that the net State Tax received by the 48 states and the District of Columbia for 1948 from the three highway-user sources were as follows:

Motor vehicles, registration, etc.	717,794,000
Motor carriers	37,389,000
Motor fuel	1,350,028,000
Total net highway-user tax received	$2,105,211,000

Of this huge sum there was allocated $1,057,515,000 for actual construction, maintenance, and administration of state highways; $570,867,000 was allocated for county, city, and other local roads; the balance was used for bond services, miscellaneous highway uses, and non-highway use. These 1948 funds did not include Federal contributions and funds from other sources such as tolls, property tax, bonds, or other funds not derived from highway-user revenue.

The total expenditures on all the roads and streets in the country increased gradually from 1920 until the beginning of World War II, following which there was a slight lull. The following figures indicate the rate of increase:

SAMPLE YEAR	TOTAL EXPENDITURES ON ROADS AND STREETS
1921	$1,321,000,000
1926	1,802,000,000
1931	2,315,000,000
1936	2,442,000,000
1941	2,116,000,000

5. PHASES, TYPES, AND MILEAGE OF MODERN HIGHWAYS SUBSEQUENT TO 1891

The years from 1890 to 1904 marked the beginning of a more or less systematic, continuous road development period in the nation. But in general, the types of road built in that period, while suitable for bicycles and horse-drawn traffic, were not the answer to the new type of traffic that was by then developing. Some of these roads could be classed as modern only in that they are still in use in local areas throughout the country and serve as farm to market roads.

The first census of American roads was taken in 1904 by the Office of Public Roads of the Department of Agriculture, the lineal descendant of the Office of Road Inquiry. It showed that there were then 2,151,570 miles of rural highways in the United States of which 153,662 had been surfaced or modernized in some form or another. Low type improvements such as gravel, shell, plank, and similar surfacing comprised the largest part of this mileage, namely 114,899 miles. There were then 38,622 miles of water-bound macadam roads, and only 141 miles of higher type surfaces.

The States of Ohio and West Virginia had constructed brick pavements which constituted the greatest part of the 141 miles of higher type pavements. There were 16 miles of bituminous roads in Ohio and two miles in Massachusetts, a total of 18 miles of bituminous pavement in the entire country. California had a substantial mileage of oiled earth roads by that time, and had actually built 18 miles of petrolithic roads. There were also 2 miles of tar-treated roads in Massachusetts and 3 miles of asphaltic roads and 13 miles of bituminous macadam in Ohio. In the years that followed, many thousands of miles of these types of roads were built throughout the country. By 1904, however, improved roads of a type higher than water-bound macadam were so few that they were in effect only experimental. England, in contrast, had built many miles of bituminous macadam and bituminous concrete roads before 1890.

The Hon. Thomas H. MacDonald, chief of the Bureau of Public Roads, in a paper read before the annual convention of the American Society of Civil Engineers in 1926, stated:

"This year, 1904, marks the end of a period. Up to that time there had been no important change in the methods of road construction which had been employed for a century or more. Either of the major types of surfacing—gravel and macadam—was known to give entire satisfaction under the traffic normal to the country roads of the time. The other types that had been developed and used in small mileage, such as the shell roads of the tidewater states and the sand-clay roads of the South, were suggested by the availability of the materials rather than by any difference in the demands of the traffic which used them."

The types of roads in existence in this country in 1904 were suitable to the type of traffic that existed up to that time, but conditions were changing rapidly and new and higher types had soon to be developed. Up to that year the only type of traffic on rural roads was relatively light horse-drawn, steel-tired vehicles. In the cities and in immediately adjacent areas there was considerable bicycle traffic while a very small number of slow moving automobiles were beginning to appear. But the speed of traffic as well as the type of vehicle were about to be revolutionized, as related in a previous section, necessitating repeated changes in road design to keep abreast with the new conditions.

During the first ten years following 1904, the lower types of bituminous roads were more and more utilized. From a total of 18 miles of such roads in 1904, the mileage increased to 10,500 miles by 1914. This type of road was found to be more suitable for light auto traffic of moderate speed than water-bound macadam. The latter type became dusty as a result of the suction of pneumatic tires, resulting in damage to the road and heavy maintenance charges, while the dust was a nuisance to the traveling public and to property owners along the route.

Light bituminous roads, however, did not continue to give satisfactory service as vehicles became heavier and trucks and buses appeared in increasing numbers. More rigid pavements, such as concrete, bituminous concrete on concrete or macadam bases, brick, block, and other high type surfaces were required for this new traffic.

From 1893, when the first all-concrete road was built in Ohio, to 1909 only about 5 miles of concrete roads were built on rural highways.[5] In that year, Wayne County, Michigan, became the pioneer, building 4 miles of all-concrete roads in 1909, 20 miles in 1910, and

[5] There were, however, a limited number of such experimental roads built in cities, one in New Brunswick, New Jersey, built in 1907-1908, being still in use.

40 miles in 1911. From that date all-concrete roads increased rapidly, with 250 miles built in 1912, then 500 in 1913, and 1,500 in 1914. By that year there were in the entire country 2,348 miles of Portland cement concrete roads. By 1924 concrete mileage had increased to 31,188 miles, with construction proceeding at the rate of about 6,000 miles per year. Concrete had outstripped all other types of improved high type pavements in new construction. Brick pavements had increased from 1,500 miles in 1914 to 4,400 miles in 1924; sheet asphalt and bituminous pavements increased by 1924 to 9,700 miles.

Out of a total of approximately 3,000,000 miles of rural highways reported in 1924, only about 45,000 had been improved with some type of hard surface better than bituminous macadam. In addition, there were 45,172 miles of bituminous macadam, 60,467 miles of water-bound macadam, and 10,000 miles of unclassified pavements, including block, etc. About 310,000 miles were improved with gravel or some inferior type of surface, but the bulk was still entirely unimproved. Yet at that time nearly 40,000 miles of rural roads were being surfaced annually, mostly with lower type pavements, at a total estimated cost from all sources of over one billion dollars per year.

During the years of World War I, there was a lull in the construction and maintenance of the highway systems, as interest lagged and roads were at first considered unessential for the war effort. But the heavy truck traffic that developed during those years caused considerable damage to the highways, few of them having been designed for that type of traffic. The question arose whether to prohibit the manufacture and operation of heavy vehicles on the existing roads or whether to design and strengthen the roads to carry them. It was soon realized that the weight of vehicles is a critical factor in highway design and it was wisely decided to "design the roads to carry the loads." Henceforth, the main roads had to be designed to carry not only the heavier loads but to accommodate the greater volume of traffic at higher speeds. Reinforced concrete pavements of greater thickness appeared, likewise wider pavements and more than two-lane widths.

Planning and economic factors, long recognized in railroad location and other engineering projects, were introduced for the first time in America in the design and construction of the New Jersey highway system. It was developed under the general direction of Sigvald Johannesson, the designer of the Pulaski Skyway, in 1930 for a Special Board of Inquiry into the best type of facility to construct over the Hackensack Meadows between Jersey City and

Newark. Three different possibilities were considered: a tunnel, a low level bridge, and a high level bridge. On the basis of an economic study prepared by Mr. Johannesson covering the three types, the Board came to the conclusion that the high level bridge would be of the greatest economic advantage, taking into account the cost of vehicle operation, money value of time, and other economic factors as well as cost of the construction. The report was accepted and the Pulaski Skyway built at a cost of $21,000,000. Later the theory and application of economics to highways was embodied in a book, *Highway Economics,* by Mr. Johannesson, the first to be published in this country.

The growing need for more and better improved highways to meet new volumes, speeds, weights, and types of traffic called for long range planning, research, investigation, and scientific analysis. Wider rights of way, multi-lanes, heavy pavements, better grading, drainage, and foundations, and elimination of causes of congestion, delay, and accidents, were necessary items to be considered. Engineers developed more initiative, greater courage, more foresight, and better planning as the needs arose. The work of the Federal government, the state highway departments, and the affiliated and cooperating associations and agencies in helping to solve the problems and providing the type of modern highways needed has already been recited.

Up to 1924 paved rural roads generally consisted of two lanes of ten feet or even narrower width. They were often referred to as having "ribbon construction." A relatively limited number were then three or more lanes in width. Little attention was paid to right-of-way widths. Most of the state highways and county roads were paved on the site of the old existing two-rod, three-rod and four-rod roads and turnpikes, and only in exceptional cases were wider right-of-way widths secured. The continued increase in traffic, number and type of vehicles, and in speeds brought about, by 1924, the beginning of another and more advanced phase of highway development in the United States.

In large cities both abroad and in the United States, wider streets and more advanced features, antedating modern dual highways and grade separations, were in existence much earlier. City streets were sometimes laid out with separating center strips planted or seeded. In New Jersey there were, for instance, such divided streets in Newark, Trenton, and North Plainfield.

Some of these divided roadways, boulevards, and parkways were in effect the forerunners of the modern dual highways and controlled-access parkways. Philadelphia had early boulevards and

parkways that were relatively advanced. The North East Boulevard, now known as the Roosevelt Boulevard, was started in 1903 as an eight-mile stretch on a 300-foot right of way, to run from Broad Street to Pennypack Park; the last section was completed in 1918. Its principal features were a central drive 60 feet wide; two side drives or service roads 34 feet in width each; and foot-walks and planted and lawn areas utilizing the remaining width.

The Southern Boulevard, completed in 1915, and a "Parkway" were also developed in Philadelphia on similar principles. Boston had similar parkways in these early years.

The Grand Boulevard in the Bronx, New York, is another such example. This, like the Philadelphia boulevards, was first constructed on a wide right of way, with a central pavement for through traffic, two service roads, and liberal park areas. Subsequent to 1910, several important cross streets were carried under the Grand Boulevard. Back earlier in the 1880's there had been constructed four depressed streets, crossing Central Park from 5th Avenue to 8th Avenue, for use of horse-drawn trucking traffic, and these may be the first examples of the modern controlled-access highways in the United States. These streets had retaining walls on both sides and other streets crossed over them by means of stone bridges.

In 1906 a French engineer named Eugene Henard published a tract on "Intersections Having Superposed Roadways." In it he states that there were then already in Paris and in other cities on the Continent several examples of highway grade separations. Mr. Henard then proposed a design for a traffic interchange with grade separations, utilizing the principles of the latter-day cloverleaf design. He also proposed the Rotary Intersection as the "general solution of the intersection problem" and as "much more simple and impressive."

The system of Gyratory Traffic Regulations, which is in effect the principle of the modern traffic circle, was proposed by Holroyd Smith as a solution for London street intersections, prior to 1907, at which time the president of the Civic and Mechanical Engineers Society gave an address discussing and advocating this plan. Early in the century the principle of the traffic circle was recommended by W. P. Eno at Columbus Circle in New York City.

In the United States, a patent was granted by the Patent Office in 1916 to Arthur Hale of Maryland for a grade separation and interchange design incorporating the basic solutions of the cloverleaf design. The Hale patent included the same principles previously discussed by Henard and Smith. The Washington circles

were the forerunners on city streets, while on state highways the Camden Traffic Circle and the Woodbridge Cloverleaf were pioneer projects in New Jersey.

There had been large vehicular bridges and viaducts constructed in the large cities prior to 1900. The famous Brooklyn Bridge had to be strengthened and reinforced by 1907 because of the increase in traffic. Other great vehicular bridges soon appeared. By 1924 there were under construction or completed the first vehicular tunnel under the Hudson River, the Camden-Philadelphia Vehicular Bridge across the Delaware, and comparable projects in other parts of the country.

In the construction of what were then called Super Highways, New Jersey took a leading role. The traffic circle as a rotary intersection based on right hand movements and one-direction traffic around the center circle had first been used in that state on the eastern approach to the Camden-Philadelphia Bridge, a project which included multi-lane roads on 120-foot right of way though not built as dual highways at that time. While the need for railroad and highway grade separations had long been recognized and while street-grade separations had been used in European and American cities, as previously recited, the grade separation of Federal Street and State Highway 25 on the Camden project was one of the first such separations on a state highway.

About the same time, the multi-lane approach road to the Holland Tunnel under the Hudson River was under construction from Elizabeth to the tunnel connection in Jersey City on a 120-foot right of way. A large portion of this Super Highway was built with no intersections at grade, and access to portions of this highway was in effect limited or controlled by physical obstruction, although there was no legislation for limited-access roads at that time. Other features of this Super Highway included the Covered Cut, the long viaduct, grade separations, designed and controlled entrances and exits, as well as the famed Pulaski Skyway. But this highway was not built on the dual-highway principle, that is the lanes in opposite directions were not separated by physical obstructions. In both of the above projects, however, one-way streets were used to enter and leave the Camden-Philadelphia Bridge and the Holland Tunnel. Traffic lights and other controls were relied upon for regulation of traffic over the larger portion of these projects.

In the late 1920's, highway grade separations and interchanges, as well as traffic circles were more or less generally adopted. In 1928 the Woodbridge Cloverleaf, the first such designed grade separation and entrance to be constructed in the country, was laid out

in New Jersey at the intersection of State Highway Routes 25 and 4.

In New York, the West Side Express Highway was constructed about the same time, and later extended by a number of parkways and scenic drives beyond the city and state line to connect with the Merritt Parkway in Connecticut. Because of growing traffic similar highways were constructed simultaneously in other parts of the country.

While something resembling dual highways had been built in some cities in the early part of the century, as previously recited, the modern dual-highway principle for traffic control, increased speed, safety, and increased capacity was not utilized or, as far as is known, proposed on any state highway construction before 1927. In that year an original plan for the construction of Super Highways in the metropolitan areas of Chicago utilizing the dual-highway principle, was awarded a first prize as the most practical solution proposed. Early in the same year, a general plan for dual-highway construction on heavily traveled highways was outlined and proposed by the New Jersey State Highway Department and was incorporated in its annual report for 1927.

The dual-highway principle of construction has been gradually adopted since that year, but it did not result in a large mileage of such highways except in a few states. By 1947 there was reported a total of 2,985 miles of such dual highways on state highways and urban extensions. New Jersey led in the percentage of dual highways but California ranked first in actual mileage. By 1947 California had 373 miles of dual highways; New Jersey, 263 miles; New York, 256 miles; and Indiana, 213 miles. Only five states had not by that time reported any dual highway construction.

By 1947 a total of 39,964 miles of multi-lane highways consisting of three or more traffic lanes were reported, including the dual highways previously mentioned. Ohio, Pennsylvania, New York, California, Illinois, and Michigan ranked first in the order named in actual multi-lane mileage. However, on the percentage basis of multi-lane mileage to total highway mileage, the order of rank was New Jersey, Massachusetts, New York, California, Ohio, and Michigan.

It is estimated that also by 1949, about 55 per cent of the entire 3,009,000 miles of rural roads will have been surfaced. However, less than 200,000 miles of these have been surfaced with high type pavement such as Portland cement concrete, high type bituminous pavements, brick, block, and similar pavements. Of the high type mileage, less than one-half, or about 94,000 miles, was built of Portland cement surface.

6. THE STORY OF PARKWAYS, FREEWAYS, EXPRESSWAYS, AND INTER-REGIONAL HIGHWAYS

The original conception of the Bronx River Parkway arose from a project to prevent stream pollution of the Bronx River and not to build a limited-access highway. It is a striking illustration of the manner in which conservation of one resource frequently leads to that of others. The death of animals in the Bronx Zoological Garden was traced to the pollution of the Bronx River and it was decided to protect the headwaters by controlling the area through which the stream passed. The parkway was conceived as the best means to this end; it was to become the first modern highway of parkway design in America.

A bill creating the Bronx River Parkway Commission passed at Albany in 1906, in the administration of Governor Charles Evans Hughes. While the first property was acquired in 1909, construction was delayed until 1916, at which time the war intervened. Work on the parkway was resumed in 1919 and completed in 1923. It was not a dual highway and it did not meet in some other respects the advanced standards of today. It did, however, utilize some modern novel features, such as separation of highway intersections by overpasses or underpasses, all crossings at grade being virtually eliminated. In that respect it went beyond the Roosevelt Boulevard in Philadelphia.

Subsequent to 1926, parkways on a more advanced and modern standard were laid out in Westchester County, New York, resulting in the development of that county's famous parkway system. Soon afterwards the Long Island State Parkways were established under the creative leadership of Robert Moses. The comprehensive system of ultra-modern New York parkways came into being, setting an example for other cities and states.

Connecticut was among the first to follow with the development of the Merritt Parkway. As early as 1926, studies began for a location to relieve the congestion and the anticipated growth in traffic on the Boston Post Road. The first contract on the Merritt Parkway, which extends a total distance of 37.17 miles from the New York State line northeasterly to the Housatonic River Bridge, near New Haven, was awarded in 1934; and its full length was opened to traffic in 1940. Subsequent to 1937, Connecticut started the Wilbur Cross Parkway which extends from the Housatonic River Bridge for a distance of about 85 miles to the Massachusetts State line at Union. A long tunnel bored through rock enables this route to bypass New Haven.

Under the common law, an owner of abutting property on a highway has the "right of access" to a public highway. With the growth in the volume and speed of traffic it became necessary, as a safety measure, to control such access, the control in most cases being exercised under the general police power of the states. In special cases, as has been mentioned in connection with the Holland Tunnel Approach Road in New Jersey, this controlled access was accomplished by design and physical limitations built into the highway. In other cases such limitations were provided by nature, as for example, the roads through the swamps in the Carolinas. In more recent years limited-access roads have been authorized by legislation in various states.

This is the "term ordinarily used for Express Highways and Parkways where access to the highway is limited or controlled at specific points or intersections and in a specific manner. Owners of property adjacent to a Limited-Access Highway do not have the right of access in front of their property that they have on ordinary streets and highways. They can reach the highway only in the same manner and at the same locations that other persons who do not own land on the highway can reach it, namely the specified and controlled intersections or entrances. On the Limited-Access Highways, which the Bureau of Public Roads designates Controlled-Access Highways, there are neither railroad grade crossings nor highway crossings or intersections at grade, and traffic lanes in opposite direction of traffic are separated by a median strip of varying widths.

"A Parkway is a Limited-Access Highway, located through a park or along which highway there are publicly-owned strips of land of considerable width reserved for landscaping, picnic grounds and other public recreation purposes. The traffic on a Parkway is ordinarily limited to passenger automobiles. Buses carrying passengers are sometimes permitted under special control. Trucks and other commercial vehicles are generally not permitted on the Parkway, although special service roads paralleling it might be provided, either immediately adjacent to the Parkway or some short distance therefrom.

"A Freeway is a Limited-Access Highway, open to all types of traffic, including passenger cars, buses, trucks and other commercial vehicles."

The principal advantages of such ultra-modern highways are that they provide the most efficient means of conveying greater volumes of traffic, with greater safety and freedom of movement and with a minimum waste of time and expense. It has been esti-

mated that parkways and freeways cut the travel time in urban areas by one-half; reduce the cost of vehicle operations to less than half as against traffic on urban streets; increase the roadway capacity by from two to three times the capacity on urban streets, and many more times as compared with especially congested areas; and reduce accidents and increase the safety of travelers by as much as ten to one in some cases. It has been further claimed that parkways have a favorable effect on property values in the vicinity, and that when properly constructed with ample service roads they cause less depreciation to adjacent properties than other types of express highways.

The New York Parkway Law of 1906 is reputed to have been the first adopted in the United States to limit or control access to public roads. It, however, referred exclusively to parkways, or roads within a public park. The first legislation for freeways, other than parkways, was passed in Rhode Island in January 1937, and in the same year New York passed similar legislation. By 1947, twenty-four states passed such legislation. Many had already constructed parkways, freeways, and expressways in and adjacent to metropolitan areas where traffic had become extremely heavy. It was soon realized everywhere that the best solution for handling extraordinary traffic and the immense increase prophesied for the future was by the modern methods of controlled access.

During the 1930's and the early 1940's, numerous parkways, freeways, and urban expressways were placed in operation. Others are in various stages of planning, design, and construction in many parts of the country. Only a few typical additional improvements will be briefly touched upon here.

The first parkway or freeway constructed on the West Coast was the Arroyo Seco Parkway from Pasadena to Los Angeles. By the end of 1940 the entire six mile section was open, doubling the traffic capacity and cutting the driving time between the two cities by one-half. A section of the Hollywood Parkway includes a unique, four-level interchange at the junction with the Arroyo Seco Harbor Parkway at Los Angeles.

In Chicago, the Lake Shore Drive, a section of which was opened in 1933, is in part an eight-lane divided parkway with unique convertible features. For a considerable distance the curbs can be raised or lowered mechanically to provide for the change in traffic flow morning and evening. It connects with U.S. 41, an express highway of dual construction from Chicago to Milwaukee.

Pittsburgh has a two-level expressway along its waterfront, construction on which started in 1939. It accommodates six lanes of

local traffic and four lanes of through traffic. This type of two level construction had been utilized early in the construction of suspension bridges over the East River in New York and at other locations. It is likely to become a feature of many future controlled-access highways and expressways.

The Davison Limited-Access Highway in Detroit is a divided expressway with three depressed lanes in each direction, with planted slopes and service roads 22 feet in width on each side. It was opened to traffic late in 1942.

The Detroit-Willow Run Industrial Expressway is another major limited-access highway in the Middle West. Built during the war years of 1943 and 1944, it is a divided highway with four 12-foot lanes, and with a median strip varying from 116 feet to 800 feet at grade, and narrowing to 16 feet in depressions. It is planned to have this expressway widened so that it will have three traffic lanes in each direction and to connect it with a new expressway to be built from Detroit to Chicago.

The distinction of being the first modern long-distance highway in America, accommodating both pleasure and commercial traffic, probably lies with the Pennsylvania Turnpike running 159.6 miles from its eastern terminus on U. S. Route 11 at Middlesex, 15 miles west of Harrisburg, to its western terminus on the Lincoln Highway at Irwin, 15 miles east of Pittsburgh. The primary objectives of this highway have been attained by piercing the highest ridges of the Appalachian Mountains with seven lighted tunnels; it has easy grades, no railroad or highway grade crossings, no local entrances and no right of entry from adjacent properties; it by-passes all cities and towns, and maintains a relative uniformity of design and direct alignment including 110 miles of straight road, with about 50 miles of easy curvature. It has two 12-foot paved lanes in each direction, divided by a planted strip of ten feet or more in width. Legislation authorizing this publicly owned turnpike and the collection of tolls was passed in 1937; the entire route was officially opened to traffic October 1, 1940. Along it are eleven interchanges or points of access and exit. Plans are now underway to extend it both east and west, to make it a trans-state highway.

The heaviest motor traffic in the world is in the city and regional environs of New York, particularly the adjoining metropolitan outlets through New Jersey and Connecticut. On State Highway Route 25 through Elizabeth, New Jersey, the average daily traffic in 1949 exceeded 48,500 vehicles; and on the section further east in the vicinity of the Newark Airport, the average daily traffic then exceeded 63,000 vehicles with a peak daily traffic in excess of 100,000

vehicles. Still heavier traffic has been predicted for this area. Such projects as the Holland and Lincoln Tunnels and the George Washington Bridge, with their approaches, were obvious necessities.

Congestion was most aggravated in the metropolitan area of New York, but similar conditions also developed in other parts of the country. On the West Coast there were constructed, to meet the requirements of growing traffic, such structures as the Golden Gate Bridge, the longest single suspension bridge in the world. This facility was built between 1932 and 1937 across the entrance to San Francisco Bay, providing an outlet for the famous Redwood Highway, on U. S. 101 to the north. The Redwood Highway had been under construction and reconstruction for many years, but its standards continually had to be revised to meet the increasing volume of new traffic.

Another great viaduct, comparable in engineering skill and ingenuity, is the San Francisco-Oakland Bay Bridge, eight and one-quarter miles long, costing about 70 million dollars. Like some of its predecessors, it is of double-deck design, providing six divided motor lanes on its upper deck with three truck lanes and two urban railroad tracks on the lower.

7. PLEASURE DRIVING, TOURIST, AND SCENIC ROUTES

By far the greatest amount of traffic is generated each day by personal and business needs. Short recreational trips daily and weekly are frequently carried on within a 20-mile radius of the place of origin. About 85 per cent of all trips are for distances of 20 miles or less; only 5 per cent constitutes trips longer than 50 miles. While small in percentages, the long-distance trips total billions of vehicle miles.

From the Atlantic to the Pacific and from the Canadian border to the Gulf of Mexico there have been gradually developed during the first half of the century may scenic highways, along lakes, rivers and near waterfalls. They wind through State and National Parks and Forests, through superb scenery, deep canyons, high mountains, and forests primeval. Many of these highways are included in the state and Federal Aid Systems, but only a few will be mentioned here as typical examples.

The beginning of the development of roads to give access to the scenic splendors in our National Parks dates back to 1877; Congress then appropriated $15,000 for roadwork in Yellowstone National Park. Limited, small-scale appropriations continued periodically until 1902 when the first substantial appropriation of $750,000 was made by Congress for roads in the Yellowstone National Park. Since

1926, when the Bureau of Public Roads became responsible for the planning and engineering of the road service in the national park system, more than 5,000 miles have been constructed. In the 1944 Federal Aid Act, there was provided the sum of about 40 million dollars to be spent annually during the three succeeding years for parkways and highways in the National Forests and Parks.

These scenic routes and national park roads differ from the modern limited-access or controlled-access parkways primarily in that they are not generally limited-access roads, and are not restricted by law against commercial vehicles, trucks, or buses. Some scenic routes may be built on modern standards but many of these are not divided highways and do not have separated grade intersections or other refinements. Park roads are so located and designed as to best reach the scenic objectives. The guiding principle in the selection of such routes is the provision of the greatest scenic value with the least disturbance to the natural beauty of the adjacent terrain, with due regard to the safety of motorists. Bridges and tunnel entrances are skillfully constructed to harmonize with the landscape and to give esthetic appearance.

The greatest progress in the development of the National Park Highways has been made since 1930. Glacier Point Highway in the Yosemite, finished in 1935, affords a breathtaking view of the Sierra Nevadas and Yosemite Valley. Trail Ridge Road in the Rocky Mountain National Park in Colorado, completed the same year, is part of the East-West Transcontinental Highway through the Park. This section ascends to an elevation of 12,185 feet, holding to approximately this level for a distance of about eight miles to its western terminus at Fall River Pass. It is the highest continuous road in America. Other sections of scenic highways, running through high-walled canyons and over the rugged mountain ranges of Colorado, are very popular with tourists. One of these leads to the summit of Mt. Evans, 14,260 ft. above sea level.

The Skyline Drive, over the Blue Ridge Mountains in the Shenandoah National Park in Virginia, extends for 107 miles from Front Royal southerly to Waynesboro. Built in the early 1930's, it is primarily a tourists' parkway, with special provisions for spacious overlooks from which visitors can view the surrounding country thousands of feet below. It marked a new standard in tourist highway development and in highway accessibility to mountain scenery.

Later, the Skyline Drive was extended further south as the Blue Ridge Parkway, to North Carolina and Tennessee. The entire 500-mile length of this continuous scenic mountain parkway, now used by over a million motorists annually, was completed by 1943.

In 1941, construction started on a 455-mile parkway on the route of the historic Indian trail known as the Natchez Trace. It was built with the cooperation of the Highway Departments of Mississippi, Alabama, and Tennessee. The Colonial Parkway in Virginia is another scenic highway in the South.

Further west, there are numerous scenic routes, among which is the Apache Trail winding through the gorgeous mountain scenery from Apache Junction to Globe in Arizona. The famous Boulder Dam-Kingman Highway runs through the same state.

In the Pacific Northwest scenic highways carry the tourists "along ocean, lake and stream, across rugged mountain ranges, through virgin forests, and across fertile farm lands and arid plains." The Pacific Highway, running north and south as a four-lane highway through Oregon and Washington, will be a favorite scenic route for tourists.

The East Side Highway in Mount Rainier National Park was completed in 1940 and opened to traffic the following year. It passes through a 507-foot tunnel, connecting with the White Pass and with Steven's Canyon Highway to encircle Mount Rainier, the third highest peak in continental United States. Other scenic highways following the north bank of the famous Columbia Gorge are notable attractions to tourists and sightseers.

The scenic highways and parkways over the California Sierras are among the most famous in the country. The Feather River Highway, "carved out of solid rock, hewn through granite cliffs, criss-crossing mountain streams," is a thrill for motorists and is the only road over the Sierras that avoids the heavy snow area of the higher altitudes. The entire route along the Feather River is one of natural beauty. This highway includes three tunnels under the Arch Rock and through the Grizzly Dome, and a 350-foot steel arch across the rocky cliffs of the canyon, 200 feet above the river.

Another of the many wonderful scenic highways in California is the Carmel-San Simeon Highway, offering 450 miles of the most beautiful shoreline scenery. Thirty-two bridges cross the numerous gorges emptying into the Pacific Ocean.

While not as widely publicized as some of the foregoing, the Boston Mountain Scenic Drive along U. S. 71 in the Ozark Mountains is one of the top accomplishments of mountain road building. This "Main Street of the Ozarks" through Arkansas from Fayetteville to Fort Smith is a 65-mile winding, canyon-skirting, scenic route carrying as many as 3,000 vehicles per day. This includes trucks and passenger cars carrying midwesterners bound for the winter playgrounds of the Gulf States. Route 71, of which this

scenic highway is but a part, is a mid-continental, Canada to Gulf, highway.

One of the best known scenic routes in the country is the Storm King Highway (U.S. 9W), running up the west side of the Hudson River above New York City and passing over Bear Mountain Bridge at Bear Mountain, New York. It is a beautiful route, carrying both heavy tourist and commercial traffic. Other scenic and historic routes running through the New England states attract thousands of tourists annually.

The Mount Vernon Memorial Highway and its extension, the George Washington Memorial Parkway, are of special interest. They run generally along the Potomac River through beautiful, historic territory, from Mount Vernon to the south end of the Arlington Memorial Bridge across the Potomac. Construction was authorized by an act of Congress in 1928, and the roadway was opened to traffic in 1932. The total cost of $7,200,000 was paid by the Federal Government. The dual-highway principle was utilized only at special sections. Rotary intersections and grade separations were also used at some locations and provision was made for terminal parking facilities for both buses and private passenger vehicles at the Mount Vernon terminus. The entire highway and its structures, bridges, and ramps were most artistically designed.

There is hardly a state in the Union that has not by this time developed highways designed primarily for the pleasure-seeking tourists. This type of highway, parkway, and scenic route is due for continuous expansion in the years to come.

New Jersey has under construction the Route 4 Parkway which is to run from Paterson southward through the metropolitan area and along communities bordering the Atlantic Ocean to its southerly point at Cape May, with a cross state parkway to Trenton. Freeway and parkway projects are planned and are under construction in Newark, Camden, and elsewhere in New Jersey.

It also has under construction an urban expressway, the Trenton Freeway utilizing the bed of the Delaware and Raritan Canal for most of its length. Another major highway improvement is Route 100 Freeway which will ultimately extend for a distance of 118 miles across the state from the George Washington Bridge on the Hudson to the Delaware Memorial Bridge now under construction over the Delaware River between Wilmington, Delaware and Deepwater, New Jersey. The metropolitan section of this freeway will initially be constructed as a four lane divided highway and will ultimately be expanded in capacity to a dual-dual eight lane highway consisting of four divided twenty-four-foot paved roadways,

two in each direction, each roadway carrying two lanes of traffic. Under recent legislation creating a Turnpike Authority in New Jersey, this road will be constructed as a toll road and is expected to be completed and opened to traffic in 1951.

Connecticut is constructing the Wilbur Cross Parkway and will continue it to the Massachusetts state line. The state also plans to continue the construction of the Hartford metropolitan area expressways. Pennsylvania has presently under construction the Extension to Philadelphia on the East and ultimately to the Ohio border on the West. Important projects are being planned or are under way in Massachusetts, Baltimore, the District of Columbia, Cleveland and other cities in Ohio, Detroit, Chicago and Florida. The cities of Houston, Dallas, San Antonio and Fort Worth have already completed portions of new urban expressways and plan for their extension. In Los Angeles, San Francisco, New Orleans, Nashville and in other cities and areas throughout the country rapid studies are being made on these new and modern urban improvements.

New York State and New York City have undertaken vast programs commensurate with their needs. The state has under construction its 486-mile four- and six-lane dual Thruway system to cost 840 million dollars. This Thruway will have feeders to New Jersey, to New England and to Canada. It is being constructed on a 200-foot minimum right of way beginning at Buffalo with extensions to the Pennsylvania State Line near Erie and running through Rochester, Syracuse and Albany to the New Jersey State Line north of the George Washington Bridge with seven main branches and sections. It will have no intersections at grade, no traffic lights, and controlled points of access with acceleration and deceleration lanes to facilitate and safeguard traffic movements at interchanges. When completed this New York Thruway will far exceed the Pennsylvania Turnpike in length although operated as a free road.

In the city, one of the connecting highways to the Manhattan Bridge Approach in Brooklyn at the Brooklyn Battery Vehicular Tunnel will have in effect a four-level structure. Furman Street will carry the local traffic below; there will be two cantilever roadways overhead carrying through-express traffic in opposite directions; and an landscaped pedestrian promenade will be constructed on the top or fourth level. With the completion in the fall of 1949 of the Brooklyn Battery Vehicular Tunnel and other anticipated projects, including a suggested underground expressway under Second Avenue in Manhattan and new parkways and expressways planned

or under construction in the other boroughs, New York will be in the forefront of modern urban highway development in the world.

Objectives change with changing needs and conditions. The primary objective in the last decade of the 19th century and the first decade of the 20th century was to "get the farmer out of the mud," provide farm-to-market roads, and build rural roads for the light traffic of the period.

Then, in the following decade, the objectives were to build dustless roads fit for light motor vehicle traffic, and a little later the objectives were enlarged because of the need to accommodate heavier traffic between cities. In due time, it became necessary to have connected or continuous hard surface, all-weather, through highways across the states and across the country. At first it was thought desirable merely to skirt the cities and let them take care of their own streets.

But as speed, volume, and weight of traffic increased, causing accidents, congestion, and delay, and as traffic studies and research enlarged the knowledge of highway needs and provided information for scientific planning, objectives and standards were raised to provide highways of such design and at such times and locations as were necessary to meet the particular traffic need. The highway needs of cities, as well as the economic justification of time, place, and type of highway improvement required, were brought to the fore by the planning surveys carried on since 1935 by the state highway departments under the sponsorship of the Bureau of Public Roads. Federal aid to cities, first authorized in 1933, was given special emphasis by the liberal provisions in the Federal Aid Act of 1944. Thus there occurred "the discovery of the cities" and urban expressways came into being.

Because of the immense funds involved in the building of the modern type of controlled-access highways, freeways and parkways, the question has arisen of financing some of these improvements by toll roads. The Pennsylvania and Maine Turnpikes are examples of modern publicly operated toll roads, and many of the publicly operated tunnels and bridges collect tolls, as do the Merritt Parkway and some of the New York City parkways. In a thorough analysis of the subject in "Toll Roads and Free Roads," [6] the conclusion was reached that in general a toll system on the national highways "is not feasible." Individual states, however, are resorting to the use of publicly operated toll roads. At least nine states passed enabling legislation during 1947 for the construction

[6] House Document No. 272, 76th Congress, 1st Session, April 27, 1939.

of toll roads and for the collection of tolls. These are Colorado, Georgia, New Hampshire, Oklahoma, West Virginia, California, Maryland, New York, and Pennsylvania. New toll legislation was defeated in some states, including Florida, Maine, Ohio, and Washington. In 1948 the State of New Jersey created a Turnpike Authority to construct and maintain a series of toll roads in the State, the capital funds for which would come from the sale of private revenue bonds, which would not involve the faith and credit of the state. In a Declaratory Judgment the State Supreme Court adjudged the Act constitutional, and the first contracts were let in late 1949 for the first toll facility between the George Washington Bridge on the Hudson and the Memorial Bridge on the Delaware—a distance of 118 miles.

The necessity for keeping roads open and traffic moving throughout the year was recognized long before 1920. All-year maintenance, snow removal, and ice control have been standard practice in all states for many years. The need for expanded highway services has been systematically recognized more and more and they have gradually been put into effect. Highway departments are issuing road-condition bulletins, publishing and distributing road maps, and some departments furnish information to tourists. Roadside improvement and protection, beautification and control, provision for picnic grounds and roadside parks with necessary parking facilities at such sites are becoming common practice in some of the states and are increasing with public demand. Control and limitation of roadside business have generally been recognized as a state responsibility. Highway lighting, cautionary and directionary signs, approach highways to and in cities and to airfields, and other similar services are generally in effect.

The problem of providing parking and terminal facilities, usually the responsibility of the municipality, is receiving some study by many of the state highway departments with Federal aid; and the provision of such facilities in connection with highway improvement in urban areas is under consideration. Other similar services, such as public provision for rest places, gasoline stations, and the like, are now considered necessary and incidental to highway operation. During the war the need for "flight strips" for auxiliary airplane landings led to their construction.

The greatest single impetus to the extension, improvement, and development of the modern highway system in this country in general and to the advanced type of parkways, freeways, and urban expressways in particular, was provided by the Federal Aid Highway Act of 1944, which was extended in 1948 for a period of

two years but with a reduction of the yearly grants-in-aid from $500,000,000 to $450,000,000.

The trend of highway development for the next two or three decades has been foreshadowed by these acts and by later legislation, providing that funds shall be made available to the states until June 30, 1955. With the Federal government and the state legislatures providing continuing funds, the long range plans based on standards outlined in "Interregional Highways," [7] and implemented by the state highway departments throughout the country, can be successfully accomplished.

But beyond the adequacy of public funds, the necessary legislative authorization, or even the improvement of the roadbuilders' art, the development of these highways of the future will depend ultimately upon the realization by highway officials and the public generally of the social significance of the highway as one of the fundamental and controlling institutions of mankind. The need to plan wisely, cooperatively, and comprehensively is essential to insure this vital service for public transportation. Daniel Burnham, Master Planner for the City of Chicago, four decades ago, wrote these words: "Make no little plans—they have no magic to stir men's blood and probably themselves will not be realized. Make big plans, aim high in hope and work, remembering that a noble, logical diagram once recorded will never die—but long after we are gone will be a living thing asserting itself with ever-growing insistency."

This injunction may well be the inspiration and challenge for future highway construction!

[7] House Document No. 379, 78th Congress, 2d Session, January 12, 1944. See also "Design Standards for the National System of Inter-state Highways" of the American Association of State Highway Officials, adopted August 1, 1945, and the Design Policies published by that Association.

2

ANALYTICAL

10 THE HIGHWAY FROM THE POINT OF VIEW OF A SOCIOLOGIST

BY CARLE C. ZIMMERMAN

The highway may be said to have the same relation to the society or civilization as does the blood circulatory system within an organic body. Of the various types of societies, the most highly advanced is the one with the most complicated and developed highway system. We may think of peasant societies such as exist in Mexico or China where the circulation of the social blood (persons, goods, economic and social values) is largely local, being facilitated from village to village and from village to town only by the most elementary roads and footpaths. Then again there are more developed societies which have this elementary circulation in the local regions but, in addition, have the chief regions tied together by a system of main post roads. Illustrations of the latter are provided by the main trails and roads in early America or the great system of roads from province to province in the Roman Empire. Finally, there is the most developed society in which the total of all-weather highways makes a complete unified system, each part of which is as facile as the other parts in doing its share in the total integration of the culture. Illustration of this last type is the present system developing in the United States where our all-weather net of land service highways of 2,250,000 miles will be integrated with 510,000 miles of more developed intermediate highways, and these in turn with 240,000 miles of main trunk multiple-channel speedways and arteries.

These three types of highway systems are inevitably associated with different types of cultures. Further, the highway systems themselves are "vehicular causal" agents in the development and imprinting of these cultural systems.

THE FOOTPATH SOCIETY

In southern and eastern Asia, where the primary heavy carriers between the industrialized regions of the world and the food-producing area and isolated peasants are chiefly waterways, with a few expensive and not greatly used railways, the primitiveness of the circulatory system imprints itself directly on the culture. Those who live near the waterways are the more well-to-do because they

can grow commercial crops, such as rice, and exchange these in the fall with the traders in their boats along the waterways. Each boat is a storehouse of industrial goods—iron and steel, salt, thread, cigarettes, religious images—and these are exchanged for the products of the countryman.

Most of the present cultures in Asia are founded upon a backbone of trader-peasants located along the waterways. The great governing cities—Rangoon, Bangkok, Canton-Hongkong, and Shanghai—represent the centers. The society consists of three elements—the small urban population in the governing city, the well-to-do peasant producing cash crops and the backwoods peasant in the far interior. Relations and understanding among these elements of the society are at a low minimum. The language differs so in dialect (particularly between the backwoodsman and the urban citizen) that the peoples have difficulty in understanding each other. This is reflected in variations in the use of letters and characters so that communication by written word is difficult. Finally, the total cultures differ in numerous details such as type of dress, type of personal adornment and, what is more fundamental yet, disease resistance. The agent of the government, whether he be for administration, tax collection, or health, cannot stand the disease varieties of the back country. Duties in these regions come to have a low estimate in the minds of public officials and are awarded either only to beginners in the governing circles who are without "pull" or as a punishment "duty" to those out of favor. As a result of this type of rule, one can easily understand that civilization in the backward regions is more and more neglected.

The national groups are often broken up by internal wars between the sections or by outside imperialisms which use the segmentation of the societies and the natural grievances of the people to disrupt the economic-state systems. Thus many elements of the Thai, the Shan and Lao are not ruled with the Thai. Each major river valley culture tends always to have its "irredentist" problem. This is inevitably closely connected with the lack of interregional and national highways. Cultural differences in the earlier years are so great that each public official going to the back country is generally reminded of the fact that he should take two outfits with him—one for working and one for returning in pomp to the governing city for the funeral obsequies.

On account of the poor circulatory system, each section of this type of country takes on social peculiarities. The city—Bangkok, Shanghai, Singapore—is urban, western, polished and cosmopolitan. It is the scene of politics, palace revolutions, struggle between the

social classes, and a modified (national-international) legislative system—law of port cities.

The group of commercial peasants located on the waterways and available fertile lands is subject to mistreatment and exploitation from all sides. The city needs money and taxes them heavily. These peasants get money for their products and, being isolated from the governing city, they are not likely to be trouble-making and revolutionary. Then, being located in fertile lands, they tend to suffer from numerous invasions either by traders or feudal ruling groups. These traders are either from the port cities or from abroad (Sikh, Chinese, Annamese, or Shanghaiese). Under either circumstances the cultural background and development of the trader class is distinctly different from that of the masses who till the soil. This "foreign" middle class gets an economic grip on the masses of the people and seeks to maintain this by any possible method. They refuse, as long as possible, to deal according to universal systems of weight, price, and exchange. This leads to the exploitation of the peasants because the middle class always has the advantage in information. For instance, the peasant does not know the market price nor does he know a standard weight and measure. The two groups—peasants vs. traders—are not bound culturally to each other by any common sympathy.

Finally, the invading armies always seek and get the best regions into their possession first of all as sources of wealth. Grain ships going to Rome from the fertile valleys of Egypt are earlier illustrations of this. Rice or soya beans for the industrial cities of Japan are modern. In the earlier periods the invasions (the Romans, Normans, or North Europeans into the fertile lowlands and valleys of England) led to the creation of feudal manors, a system of social organization where the status of the ordinary individual became that of a serf, villein, or colonus, in comparison with the freer status of the Celts, Welsh, and Highland Scotch. Later these foreign feudal lords were replaced by naturalized persons or a native group, but the system of taxation and exploitation between the man and the gentleman still continued. The modernizing of the country is associated with a long struggle as to who gets the land (the lord, as in England, or the common man, as in Scandinavia and northern Europe.) The settlement of this issue has long influenced the character of the civilization of a given region.

In southeastern Asia the population in the river valleys suffers from two other difficulties inherent in their semi-isolated position—the diseases of the lowlands (of which malaria is most outstanding) and the ever possible famine connected with intense cultivation,

heavy population density, and fluctuating weather conditions. Land becomes more valuable than people and the people suffer.

In the outskirts and backwoods of such societies an entirely different culture grows up. Communication with "civilization" is so difficult that the people live almost entirely to themselves. If they have some valuable light product such as opium, sticlac, or tree-tea, they can carry enough once or twice a year to the nearest river town to buy the most needed products which they cannot produce—pieces of iron, salt, thread, or quinine. Others raise cattle and drive them to the markets. This herding of stock, however, has its difficulties because the spread of cattle diseases by the primitive outlying cattle is not welcomed by the farmers near civilization. The backwoods peasants are often forced to go into domestic manufacture of light goods such as the native serapes of the Oaxacan Indians. These, when taken into the river towns or railheads, generally bring pitiful prices compared with the infinite labor of the "domestic slaves"—women and children—that goes into their manufacture.

Government in the hinterland is almost purely local, and in the long run this means the feudal trustee family rule in which individual conflict means family conflict. This leads to feud and blood vengeance unless the governing society knows about it and steps in with immediate and drastic enforcement of public law. Ordinarily, however, the conception of public law is what the jurists call *themis*. Natural justice has to be highly flavored by the strength of one's clan, family, kin, and connections (or one's personal reputation as a fighter).

Each village tends to take on its own peculiarities and is known by dress and dialect. The culture is colorful from the standpoint of the sociologist, but certainly not humane and civilized according to our Graeco-Roman-Christian set of values.

The population within these regions is thin and constantly devastated by exceedingly ruinous epidemics of fatal or disfiguring disease. Framboesia (yaws), upland malaria, hookworm, insect-borne parasites, trachoma, and kidney stones generally rage unchecked and are not even understood by the people. The cost of treating these diseases is slight but those suffering do not have any remedy, and those who are on the outside do not know the situation.

Finally, we have the peculiar anomaly that societies of this type are overpopulated in the river valleys and underpopulated in the regions where many of the greatest and most fundamental resources are to be found. This is true wherever you find societies built about only the footpath supplemented by water communication and, more

recently, by a few railroads. Java has its Sumatra; the Menam Valley in Thailand has its Korat Plateau; Luzon, its Mindanao; Shanghai, its Manchuokuo; and all the densely populated lower valleys of the Asiatic rivers, their upper and practically neglected regions. This is due, in part, to the fact that migrations are not to the open lands but rather to the regions of commerce and economic opportunity.

THE POST ROAD SOCIETY

This type of society is more developed than the first, in that the government eventually integrates all the major regions by connecting arteries of communication, so that even if the roads are still too expensive and difficult for commerce, a common culture and standard of rule and regulation are enforced through the whole society by governmental agents, missionaries, soldiers, judges, and teachers. Illustrations are the diffusion of Roman law into Gaul and the spread of a common Russian tradition and rule throughout all the diverse peoples of northern Asia by the Soviet. The missionaries—Christian, Barbarian, Mohammedan, Buddhist—circulate freely in these new districts under the protection of the governmental agents. These missionaries, soldiers, judges, and teachers begin to introduce the law, the humanitarianism, the nationalism, and the ideas of the most cultivated part of the society into the outer fringes. Law in the back districts moves from the family and from expediency into the courts, acquiring a conception of abstract justice. Law itself becomes an orderly coordinating social force. This is supplemented by the empire religion or system of faith, whether this be Adam Smithian economics, patristic Christianity, or U.S.S.R. Pan-Slavic nationalism.

To some extent the modern steel railroad has taken over the place played by the original post roads integrating the primary governing and administrative centers. These have many advantages in speed and are easier to construct through the river valleys than are the post roads. At the terminals of these rail lines, the post roads are continued into the highlands and isolated places to the lesser administrative centers. The whole system tends to grow within itself once started, because the roads bring money income to the people and money income makes the transportation pay.

The influence of this whole system tends to break down the localisms and the disadvantages of the previous foot-path isolation and to create a new culture. The missionary, the trader, the judge, and the soldier bring the language and writing of the city into the outlying regions. These men are used to dealing in standard weights

and measures and according to market prices. Agencies of communication of news also arise, bringing with them market prices.

The changes brought about by this system are, on the whole, exceedingly advantageous to both the local people and the society at large. However, it would not be fair to point out all the improvements without also indicating the confusion and demoralization which arises.

In the regions where the wealthy farm people live and produce nonperishable farm goods, a good deal of the visible exploitation of the country people tends to cease. The people hear of market prices and quotations and are better informed in market transactions—both buying and selling. They also begin to wish to get out from under their feudal lords and conquerors because trading and commerce are impeded. A struggle of the masses against the classes begins. The trading groups find it to their advantage to intermarry with the producers. Good will tends to displace exploitation in economic dealings and this is to the advantage of the provincials. A locally-born middle class arises, either from the local people or as the spawn of the intermarriage between the trader and the peasant. The ruling groups hear of the conditions in the provinces and try to meliorate some of the deficiencies which arise because of crop failures and inequitable taxes. The diseases are called to their attention and the provincial towns become educational centers to help remove some of the worst plagues.

On the other hand, one of the first tendencies of the people is to unbalance their agriculture toward more and more buying and selling in place of a former combination of production for home consumption with that for the market. The country no longer supports only its nationals but goes into the export business for the basic crops. This is a complicated change because the producers of crops with heavy fixed costs and light variable ones are selling them on market schedules of inelastic demand in an international market. The country people come into international competition with their crops. They no longer have a surplus of domestic goods at home to take care of basic maintenance needs in case of crisis, war, or extremely depressed prices.

Furthermore, the people begin to increase consumption of economic goods brought in which are attractive and expensive and are not best from many points of view. In some of the valleys of Asia, for instance, cigarettes, gun shells, and white or polished rice become items of increasingly greater use. Before that time they consumed local tobacco wrapped in vegetable leaves. The improved gun shells enable them to kill off the game which was once an im-

portant source of protective food. The local water sites are drained for cultivation. Soon they are eating imported salt-fish (as in Buddhist countries). This, along with the finer polished rice or grain flour, which has also lost its protective food value, leads to a growing deficiency in vitamins, minerals, iron, and protective foods.

The greatest social change begins to take place in the backwoods. Family law has to give away to national law. The government and the people are at odds with each other over law and custom. They begin to produce more and more goods for sale, and money comes into common circulation. Disease begins to be treated according to the pharmacopoeia of the things known in the large city. Population begins to increase and to move in toward the center of the culture. The people in these regions begin a series of short-term population migrations—in and out of the city, the army, industry, or anywhere to make money temporarily. The returning migrants bring in new ideas—some of which are adaptable to the native cultures and some of which are rejected. The family system makes the greatest change; next comes disease treatment, both in man and animal; finally the local economic system becomes part of the international system. The hill-billy and the backwoodsman are becoming civilized.

The whole series of changes coalesce into the same thing. With the roads come letters, mail, news, teachers, writing, government correspondence, and improvements in public administration, economics, and standards of living.

One important change is the entrance of the surplus population from the back regions into the national armies. The people are fitted for this by early training. The pay of the soldier is real money to him. It is an easy avenue into the larger society. Soon the armies become filled with backwoodsmen—barbarianized—as they used to say in the Roman Empire. When the army seizes power, as often happens, a sturdy backwoodsman may become emperor almost before he learns to read and write. This is true in parts of our contemporary world and was certainly true in the later Roman times.

THE HIGHWAY SOCIETY

The society based upon a complete system of highways and rapid communication is the next step. This development is relatively recent in world history and one which we understand least and about which we have most need for knowledge. Many societies get to the post-road stage and advance no further. Recently certain western European societies have gone the whole way. The most typological manifestation of this is provided by the United

States of America. The following remarks are made upon an observation of this society but they probably apply to future developments in many other countries, particularly those large land masses like the U.S.S.R.

The chief characteristic of such a society, from the point of view of transport, is the development of a complete highway system. It starts at the very edges of the civilization with elementary roads needed only a few times a year, and feeds into smaller permanent roads used daily. Above this, and fed by the lesser roads, is a complete hard-surfaced system uniting the smaller communities into aggregates of units necessary for communication and transportation. These have ordinarily been called land service roads. They integrate the greater and lesser retail trading centers with each other and with the outlying farms, homes, and producing industries. They have the greatest mileage of highways in the country and their functions may be contrasted with the lesser blood vessels which serve each organ of an integrated living body.

Above these groups are the intermediate roads which go to the wholesale and city level. The retail centers are united to the smaller industrial and wholesale centers. These roads, lesser in mileage, are more important in load per mile because of the heavy rapid hauling and fast traffic. The different smaller organic systems are organized into greater units, which may be the "metropolitan" community groups. St. Louis, Minneapolis, Kansas City, Baltimore, Dallas, and the smaller metropolitan centers are united to their hinterland systems by such roads. The larger metropolitan centers have such road systems, too, uniting them to their basic background communities in the same way, because the larger centers not only have smaller metropolitan satellite systems but also their local hinterlands. These intermediate roads are the lesser trunks leading into the systems which are probably marked off best from each other by the circulations of metropolitan daily newspapers.

Above this system are the main trunks, uniting the great communities with each other and sometimes being transcontinental in scope. These main trunks generally comprise a small percentage of the actual mileage of the roadways of the country, but they are extremely important. They are like the great arteries and veins leading directly from the smaller organic systems to the heart. Or, in another figure of speech, they are like the main valleys of great river systems, being fed by smaller river systems and facilitating the drainage functions of the whole river shed. These speedways, four-, six-, and even eight-lane highways, will probably be isolated eventually from contact with other communication systems except

at long intervals. Eventually they will probably avoid direct contact with the smaller towns and even great cities. They will be divested from all cross interference by smaller roads, railways, and other traffic hazards. They will possibly have classified traffic channels and be exempt from the ordinary speed regulations inflicted by the whims of local or state legislative jurisdictions.

Such a highway system as this, which already is partly developed in the United States and only awaits perfection, exists along with a civilization which is considerably different from those social systems where there are only footpaths or those with post roads. This is not a causal analysis, but a description of the society in which the highway is partly cause, partly effect, and at all times a facilitating agent.

It would seem at first that such a society would be based upon great regional division of labor. Cotton can be produced so well in the South and manufactured in New England that theoretically this division would continue and be accelerated. It would seem that corn would be produced almost solely in the corn belt, cattle in the plains, and the feed lots would concentrate near the larger cities. Each region would specialize only in those things which it could do best, and the transfer of goods from one region to another would be so rapid and cheap that the economic system would be efficient indeed.

However, this is not entirely the case. Ideas and techniques will pass from one section to others. Each individual place will seek rather that combination of industries and occupations which will give it the greatest complete economic use of all its resources, including its labor supply. Thus the South will gain forms of economic production found in other regions and New England will also "pirate" into the forms of money making which it can borrow from the others.

This mixing of economic competition will be primarily in the lighter industries and in those forms of production where labor or time surplus during a part of the year will be the deciding factor. Even under this highway system, land transportation of raw materials will tend to keep the heavy-goods industries located near supplies. Most agrarian production is localized primarily by factors other than transportation and as such will continue. Although the effects of this transportation system on economic production will be profound indeed, the social aspects will be most important.

The things affected most by the completion of the highway system will be the movements of people, light goods, consumers' items, and social values. People will move from one side of the

country to the other more for pleasure, for health, for work, and just "to see the world." Light-goods manufacturing, already rather considerably deregionalized as a result of the development of war plants over the country, will continue to thrive in new communities where inventors, businessmen, established firms, and surplus labor are to be found. While light-goods manufacturing tends to be regional in order that small parts may be readily exchanged, this development of sufficient density for local division of labor will not be difficult. Competition among these business units will be severe because transportation costs in time and money will not be great. The deciding factors in any region will probably be the supply and attitudes of the working force, availability of power, and the ingenuity of the local businessmen; other factors will probably be of less importance.

Consumers' items of all types will spread rapidly from one region to the other. Frozen sea food will be trucked to the inland towns and fresh vegetables from the semi-tropical regions will come into interior America. Isolated communities formerly lacked these things at certain seasons because of use of less than carload lots. The similarity of consumption in all important parts of the country will be a significant fact in the spread of common systems of social values. This is embryonic in the United States now but will develop more.

The speeding up of transportation in small lots, the freeing of channels of movement from established railway and water lines, and the reduction in cost of movements of small units will unquestionably have a profound influence upon the consumption habits of the American people. Small changes in economic margin will offset the transportation barriers under this developed highway system. As a result, the American as a consumer will more and more approach a standard type.

This will be a very interesting and complicated process to watch. If a few people in Kansas City want 93-score butter, this demand will be met long before some enterprising agent develops a demand so as to handle it in carload lots. After that, the Missouri or Kansas farmer nearby will be stimulated to deliver his whole milk to the creamery fresh, and he will start producing 93-score butter to meet the Kansas City demand. The road system which brought in the butter by truck will also facilitate picking up milk from outlying farms before it sours. The standard American consumer will develop into a reality. To a considerable extent, a more standard American interior urban community will also arise. The "mainstreet" will no longer be merely provincial. It will tend to be semi-

urbanized, on the one hand, and to fall into a standard pattern, on the other.

Important consequences in the long run, however, will be due to increased temporary movements of people. From this and the mixing of other customs, there will arise a more unitary American value system in all sections of the country. Transportation, being freer and more rapid, will help the ordinary family in the interior regions to move about more often than ever before. (We may presuppose that the development of this highway system will be a causal agent in the increase of cheaper vehicles of rapid and convenient transportation.) Strangers will deal increasingly with strangers and the elements making for homogeneity in standards, values, and moral codes will receive greater emphasis.

Along with this, protective systems against uniformity and against the mixing of value systems too far will have to be developed. People will still want to have private lives somewhat uninfluenced by contact with strangers, so that the agencies for preserving primary face-to-face conduct will have to be strengthened. Clean public toilets and formal courtesy to strangers will increase; the willingness to include the stranger in the local personal value systems will decrease.

The facilities for the spread of "good" social values will also be useful for the spread of crime and demoralization. Steps will have to be taken by numerous communities and agencies to protect against these. State and Federal police systems will grow at the expense of local, and the right of pursuit by local agents of law and order will have to be extended.

The summer home idea will develop more near the metropolitan centers. People who formerly have gone to the popular places by the sea will go farther in order to be alone. The summer tourist industry, with all its complications, will increase. Definite legal protection will have to be developed to protect the tourist from the local communities and the community from the tourist. Highway beautification will become more important. The right of defacing the sight view of public highways will have to be limited in the interests of taste and safety. These and hundreds of other modifications of accepted social values will have to be made, probably not too far in the future.

Political value systems will have to become more national and less regional and local. The surface similarity of peoples in all sections of the country will have great influence upon the appeals from political parties. Persons formerly escaping their full share of social duty, due to the fact that some immigrant, farmer, or hill-

billy did more than his share, will find that a similarity of Americans will mean a greater sameness in sacrifices demanded of all.

CONCLUSIONS

In this newer society, the problems of social management will change. Actions of one part of the social system will have a more direct and drastic influence upon all. An integrated division-of-labor society must be healthy in all parts or not healthy at all. Regional problems become nationalized, all the way from treatment of minority groups to the waste of oil, gas, timber, soil fertility and other natural resources. Classical economics will have to give way toward newer teachings of a more "trusteeship" variety. Many of our conceptions of property rights will have to be modified by declarations of duties. New fields of social science such as national and regional sociology will have to be developed. New courses on "social problems" will emerge and their doctrines will be unrecognizable to many followers of nineteenth century classical liberalism.

Footpath, post road, and highway societies are organic types of civilizations, not necessarily related in an evolutionary or developmental series, but certainly differential expressions of the same principle—emphasis upon society as against the folk. Yet to some extent this is a statement with limits, because highway systems in time tend to make the greater society a folk. The development of this in the United States in the next decade will be an interesting phenomenon because it will be associated with our more general coming of age as a world power and as a continental unity. In the future *e pluribus unum* will have a greater meaning for us than as a misunderstood motto on the silver dollar.

11 THE HIGHWAY AND SOCIAL PROBLEMS

BY FRANCIS E. MERRILL

THE HIGHWAY AND MOBILITY

THE highway is a symbol of American mobility. The citizen out for a drive on a Sunday afternoon, the commuter on his daily automobile ride, the interstate passenger on the express bus, the Joad family on the move from the dust bowl to sunny California, the warworker leaving his eroded farm for the shipyards and aircraft factories of the Pacific Coast, the adolescent taking the family car to the roadhouse or tavern at the edge of the city, the bank robber making his escape in the conventional small black sedan—these are only a few of the aspects of American mobility which have arisen in conjunction with the highway and the automobile. America has become a nation on wheels, with all that this situation implies in the dissolution of many of the traditional patterns established during long periods of comparative social stability.

This essay deals with some of the effects of social mobility which has been either induced or intensified by the automobile and the highway. This behavior has been defined by the majority of persons as constituting a deviation from certain social norms and hence as a social problem. As one of the principal media of transportation and communication in a highly mobile society, the highway has brought about numerous changes in behavior which are considered either desirable or at least not highly undesirable to the established social values. These changes will be considered elsewhere in this symposium. The present essay is concerned only with such phases of social mobility as constitute social problems.

Social mobility involves the tendency of human beings to move about over the surface of the earth.[1] The automobile and the highway have made it possible to satisfy this propensity more completely than ever before. This tendency has been especially manifested in America, which has become the land of social mobility *par excellence.* The combination of great natural resources and a scanty and unorganized aboriginal population has produced in America one of the most impressive and sustained movements of population the world had ever seen. As a result of these movements, the country was settled by a restless and volatile people who perforce never

[1] Pitirim A. Sorokin, *Social Mobility* (New York, 1927).

established many of the firm social ties of a stable environment. The peregrinations of the pioneers were intensified a thousandfold by the mobility afforded by the automobile. The dynamic character of American society owes much to the first rude highways over which toiled the pioneers on horseback, on foot, in wagons, and in prairie schooners. It owes even more to the hard-surfaced highway which today links the country in a huge and mobile network.

The extent of American mobility had frequently been noted but never nationally measured until the Census of 1940. At that time, the question was asked, "In what place did this person live on April 1, 1935?" "Migration status" was determined on the basis of the answer. A migrant was defined as a person who lived in a different county (or quasi-county) in 1940 and 1935. A quasi-county was considered as a city of 100,000 or more and the remainder of its county as another county. Migrants thus defined comprised: "(a) Those living in different counties in 1940 and 1935; (b) those living in a city of 100,000 or more in 1940 but living elsewhere in the same county in 1935; and (c) those living in a city of 100,000 or more in 1935 but living elsewhere in the same county in 1940." [2] The last two categories included those persons who moved from or to cities of 100,000 or more from or to the surrounding suburban areas between 1935 and 1940. The method of locomotion involved in these movements was not stated and hence it is impossible to determine the exact role of the automobile, the bus, and the other agencies of transportation making use of the highway. Especially in the short movements, the role of the highway must have been central.

The total number of persons thus defined as migrants between 1935 and 1940 was 15,734,798, or 12.0 of the total population in 1940. This total was further subdivided in terms of the following categories: "(a) Migrants within a state, (b) migrants between contiguous states, and (c) migrants between non-contiguous states." [3] As might be expected, the largest number of migrants (9,239,749) moved within a state, with 3,142,257 moving between contiguous states and 3,352,792 between non-contiguous states.[4] The majority of the migrants in 1940 were living in urban areas, with 56.5 percent of the total in this category. Of the urban group, 27.6 percent were living in cities of 100,000 or more and 28.9 living in other

[2] Bureau of the Census, Sixteenth Census of the United States: 1940, *Population: Internal Migration 1935 to 1940, Color and Sex of Migrants* (Washington, 1943), 1-2.

[3] *ibid.*, 2.

[4] See Table 1, *ibid.*, 5.

urban centers, defined by the Census as comprising all "cities and other incorporated places having 2,500 inhabitants or more." The non-urban migrants were divided as follows: 19.0 in rural-non farm areas; 19.2 in rural-farm areas; 4.2 rural but no report whether farm or nonfarm; and 1.2 whose rural-urban status was unreported.[5]

Social mobility rose to unprecedented heights during World War II. Estimates by the Bureau of the Census indicated that approximately 15,300,000 members of the civilian population (12 percent of the non-military total) were residing in a different county in March, 1945 than on December 7, 1941.[6] This wartime total did not include the more than 12,000,000 men and women in the armed forces, whose mobility is proverbial, nor those who moved from one county after Pearl Harbor but returned thereto on or before March 1, 1945. Even without this last indeterminate number, the combined total of civilian and military migrants between Pearl Harbor and the final few months of the war was approximately 27,300,000 persons. "Never before in the history of our country," comments the Bureau of the Census, "has there been so great a shuffling and redistribution of population in so short a time." [7]

The large-scale movement continued during the early years of the postwar period. In the 14 months immediately following the end of the war (i.e., from August 14, 1945 to October 1, 1946), an estimated 10,700,000 persons changed their county of residence at least once as civilians. Approximately 10 per cent made more than one inter-county move, and 3 per cent moved three or more times. Six million of this number moved for reasons connected with their jobs, or with those of the head of the family, whereas 1,900,000 moved for reasons directly or indirectly related to the housing situation. As might be expected, the rate of postwar migration was highest among veterans, who were concentrated in the younger and most mobile age groups, as well as constituting the largest body in search of jobs. An estimated 11.7 per cent (1,500,000) of the total male veteran population made one or more moves as civilians during the above interval.[8] The impact of World War II

[5] See Table II, *ibid.*, 4.

[6] Bureau of the Census, Population—Special Reports, *Civilian Migration in the United States; December, 1941 to March, 1945,* Series P-3, No. 5 (September 2, 1945).

[7] *ibid.*

[8] Bureau of the Census, Current Population Reports: Population Characteristics, *Postwar Migration and its Causes in the United States: August, 1945 to October, 1946,* Series P-20, No. 4 (October 7, 1947).

upon the mobility of the American people was felt long after the last shot was fired.[9]

THE NATURE OF SOCIAL PROBLEMS

A social problem has been defined as a "condition which is an actual or imagined deviation from some social norm cherished by a considerable number of persons."[10] Social problems have both subjective and objective aspects. The objective aspect comprises human behavior on a comparatively large scale which can be measured and verified by impartial observers. Before such behavior becomes a social problem, however, it must be defined as such. This means that a considerable number of persons must become convinced that the situation constitutes a menace to one or more social values. In this context, social values are those norms whose continuance we consider necessary to the continued efficient functioning of the social order. These norms must be questioned by the existence of certain behavior before the behavior itself constitutes a social problem. In the last analysis, social problems are therefore what people *think* they are, the consensus being based upon an alleged infringement of common values held by the majority of the group.

The importance of social definition of the same mass behavior was illustrated by the different public attitudes toward mobility during the depression and the war. Depression mobility was viewed by the general public and the authorities alike as an unfortunate manifestation of an economically and socially stagnant society. The thousands of dilapidated automobiles clogging the western highways on the road to California were defined as an outward and visible sign of an inward decay of the social structure.[11] Similar movements during the defense and war years, on the other hand, were considered an indication of a dynamic and virile social or-

[9] Bureau of the Census, Current Population Reports: Population Characteristics, *Internal Migration in the United States: April, 1940 to April, 1947,* Series P-20, No. 5 (October 31, 1947).

[10] Richard C. Fuller and Richard R. Myers, "Some Aspects of a Theory of Social Problems," *American Sociological Review,* (February, 1941), VI, 24-32.

[11] For studies of the depression mobility, cf. John N. Webb, *The Transient Unemployed,* Works Progress Administration, Division of Social Research, Research Monograph III, (Washington, 1935); John N. Webb, *The Migratory-Casual Worker,* Works Progress Administration, Division of Social Research, Research Monograph VII, (Washington, 1937); John N. Webb and Malcolm Brown, *Migrant Families,* Works Progress Administration, Division of Social Research, Research Monograph XVIII, (Washington, 1938).

ganization, which could assume the gigantic task of war production with a minimum of dislocation. The process of reshuffling millions of workers, much of it carried out on the highways of the nation, was accomplished with comparatively little formality and with the tacit approval of all concerned.[12] The dislocation in the personal lives of the mobile persons was largely overlooked or, when considered at all, was viewed as an unfortunate but unavoidable concomitant of total mobilization. The fundamental social process was much the same in either case. The social definition was very different.

Social values play an active as well as a passive role in the definition and solution of social problems. By definition, the problem exists because of the violation or presumed violation of a certain value or values. Once called into question, the value pattern may obstruct the solution of the problem, since constructive action may threaten even more fundamental values. In the case of the highway, for example, the mobility engendered by the automobile may largely nullify the traditional parental and neighborhood control of sex relationships and in the process endanger the values embodying pre-marital sex restraint. Other values are also grouped about this mobility, however; nobody seriously considers curtailing the freedom of the road in order to curb departures from the sex norms. Freedom is too precious a value to endanger in an effort to eliminate threats to other and less precious values.

MOBILITY AND SOCIAL PROBLEMS

We may now consider some of the forms of behavior brought about or accentuated by the automobile-highway complex and defined as infringements upon certain social norms and hence as social problems. These problems involve complex behavior patterns and the following considerations by no means constitute definitive analyses thereof. Sex delinquency, prostitution, and crime are extremely complex in genesis and in possible solution. The mobility engendered by the highway constitutes merely one of a number of causal or concomitant factors in these problems. The automobile enables large numbers of persons to spend their leisure hours engaging in behavior which has been socially condemned since the days of the settled community. A smaller but still substantial number devote themselves exclusively to catering to these illicit pleasures which are made possible largely by the freedom from

[12] Howard B. Myers, "Defense Migration and Labor Supply," *Journal of the American Statistical Association,* (March, 1942), XXXVII, 69-76.

control in a mobile and anonymous half-world of strangers. The automobile-highway nexus obviously does not provide the sole "cause" for such behavior, which existed long before the internal combustion engine and the hard-surfaced road. At the same time, however, these aids to mobility have contributed to the relaxation of social control which renders many such activities more difficult to regulate.

1. *Sex Delinquency and Mobility.* Sex delinquency refers broadly to the exercise of sex relations in a manner defined as contrary to the welfare of the group. Such behavior may involve either premarital or post-marital sex relations. In either case, the group imposes its standards largely through the informal control exerted through the primary group. Such control operates most efficiently in a settled and stable community, where the individual is closely watched by family and neighbors and the penalties of transgression are swift and sure. Under the conditions of rapid mobility offered by the automobile and the network of highways extending in all directions from every important center, any such informal supervision is clearly impossible. In the metropolitan area the adolescent can quickly absent himself from his own community and appear in another where he is known to nobody. In the smaller city the adolescent can often be in another town in a matter of minutes and in an environment where his or her sexual behavior is a matter of negligible interest to anyone. The village offers many roads leading into the open country, where dark and shady retreats provide ideal places for escape via the automobile from traditional social controls.

Concrete evidence on the role of the automobile and the highway upon behavior defined as sexually delinquent is difficult to obtain because of the nature of the activity. In his report on the recreational habits of the younger generation in Mineville, Blumenthal states that the automobile offers unfair competition to the competitive athletic enterprises of the community.[13] The Lynds report that a large proportion of the young girls in Middletown brought before the juvenile court on charges of sex delinquency maintain that the behavior took place in the peripatetic anonymity of the automobile, far from the prying eyes of family or neighbors.[14] On *a priori* grounds, such representative experience is probably duplicated in other communities large and small in all parts of the country. The complete privacy offered by the automobile and the

[13] Albert Blumenthal, *Small Town Stuff* (Chicago, 1932), 246.
[14] Robert S. Lynd and Helen M. Lynd, *Middletown* (New York, 1929), 258.

mobility of the open road unquestionably provide unequalled opportunities for such behavior. The extent to which these opportunities are utilized can never be accurately known.

2. *Prostitution and Mobility.* Prostitution is characterized by a relationship which employs "sexual stimulation in a system of dominance to attain non-sexual ends." [15] Prostitution also involves highly mobile persons who move through the anonymous world of the large city and thereby escape much of the control applied to more stable persons. Prostitution in the center of the city is as old as history and depends on no more rapid forms of locomotion than have been provided since ancient times. The rise of prostitution on the periphery of the large city, however, is a direct function of the automobile and the paved highway. Without these two modern adjuncts to mobility, prostitution would have remained in the center of the city or in the interstitial areas immediately adjacent thereto.[16]

The automobile enables the patrons of prostitution to journey to the outskirts of the large city where facilities have been provided by interests quick to capitalize upon this new mobility. "While levee characters and pleasure seekers have sought the freedom of the urban frontier," comments Reckless, "their outlying business and pleasure would have been practically impossible on any large scale without the automobile and paved highway. The easy accessibility," he concludes, "has . . . enabled emigrant vice lords, inn keepers, gamblers,. . . [and] slot machine syndicators to play host for the joy-thirsting public which owns or uses automobiles." [17]

The small towns and incorporated places at the outskirts of the metropolitan areas often exhibit a related aspect of social mobility which is either generated or enhanced by the highway. Community control tends to be lax or completely non-existent in many such areas, since the inhabitants have not been established long enough to develop community consciousness and in addition do not consider themselves permanent residents. Roadhouses which make prostitution their major enterprise or engage in such activity as a profitable sideline to gambling or other forms of entertainment tend to arise in these areas with undeveloped social consciousness. The profitable nature of their operations enables the entrepreneurs to bribe or otherwise corrupt the municipal authorities of these outlying areas and prostitution becomes firmly intrenched. The

[15] Kingsley Davis, "The Sociology of Prostitution," *American Sociological Review,* (October, 1937), II:745-756.

[16] cf. Paul G. Cressey, *The Taxi Dance Hall* (Chicago, 1932), Chapter XII.

[17] Walter C. Reckless, *Vice in Chicago* (Chicago, 1933), 134-135.

net result of this situation is that "The city's hinterland, due to the lack of policing and to the lack of a vigorous public opinion in the sparsely settled outskirts of the city, has become a haven of vice." [18] The mobility brought about and intensified by the automobile and the highway thus involves another aspect of behavior defined as a social problem.

3. *Crime and Mobility.* A third social problem which is initiated or exacerbated by the mobility of an America on wheels is the variety of behavior defined as criminal. The automobile provides the most satisfactory method yet devised for escaping detection on the part of the criminal population. The network of highways connecting large metropolitan areas offers a convenient method of escape for criminals, just as it provides a means of access and egress for the law-abiding citizens. The use of the automobile to carry out such spectacular forms of criminal enterprise as robbery with a gun and attendant forms of homicide is too well known to warrant more than passing mention. The extent to which the automobile figures directly in these crimes is not accurately known. It is impossible to say how many of the 7,620 murders and nonnegligent manslaughters, the 16,180 cases of rape, the 377,640 cases of burglary, or the 978,000 cases of larceny known to the police in 1948 involved the use of the automobile at some stage in the activity.[19] The number of criminals making use of this convenient form of anonymous mobility was doubtless very large.

Other forms of criminal behavior involve the automobile and by implication the highway more directly. These are the forms wherein the automobile figures as the instrument by which the crime is committed or as the object of the crime. The first refers to manslaughter by negligence, consisting largely of traffic (i.e., automobile) deaths, and which in 1948 amounted to 5,390 fatalities.[20] The second refers to auto theft, which in 1948 was estimated at 169,540 offenses.[21] Although approximately 95 per cent of all stolen automobiles are ultimately recovered,[22] more or less the worse for wear, this form of activity constitutes an important aspect of the criminal pattern. Many of the murders, non-negligent manslaughters, rapes, burglaries, and larcenies are committed by persons driving stolen automobiles who subsequently abandon them after the crime has

[18] *ibid.*, 136.

[19] Federal Bureau of Investigation, *Uniform Crime Reports,* XIX, No. 2, Annual Bulletin, 1949, (Washington, 1949), 111.

[20] Federal Bureau of Investigation, *op. cit.,* 111.

[21] *ibid.*

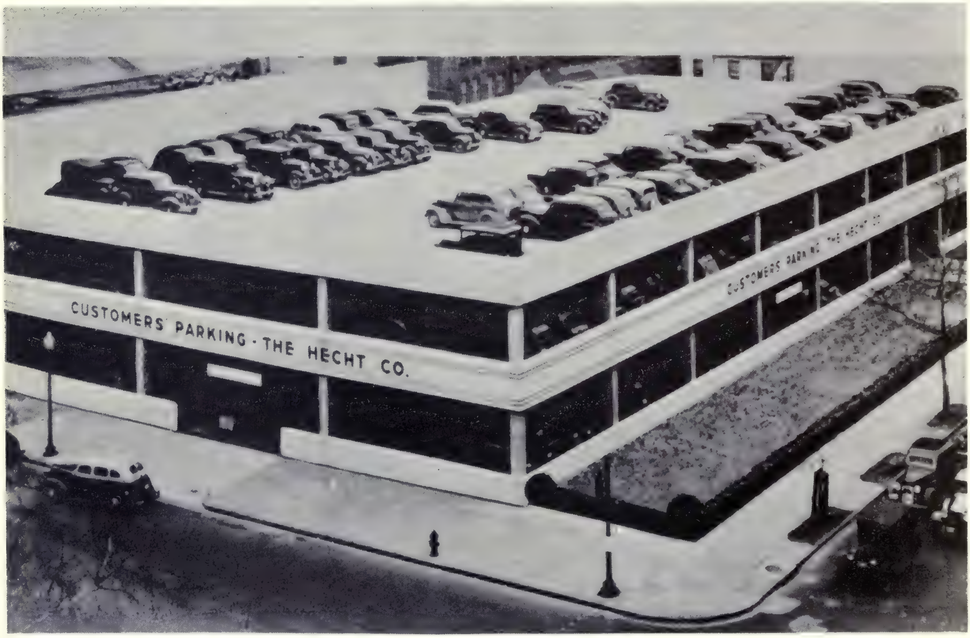
[22] *op. cit.,* 103.

PORT OF NEW YORK AUTHORITY

NEW YORK UNION MOTOR TRUCK TERMINAL

The first of its kind in the country, this terminal was built by the Port of New York Authority as a solution for truckmen seeking a centralized place for loading and unloading freight. It was opened in 1949 and is expected to reach a capacity volume of 2,000 tons a day, thus lowering handling costs materially and also reducing the number of trucks in the city streets.

A "PARK AND SHOP"



A PARKING BUILDING

been committed and the escape effected. The automobile thus constitutes an important subsidiary in the arsenal of crime. The highway serves the innocent and the guilty alike.

Another group of criminal activities is estimated by the Federal Bureau of Investigation from arrest records evidenced by fingerprint cards (as distinguished from the behavior enumerated above which is classified as "offenses known to the police"). One of these is driving while intoxicated. In the hands of a person rendered incapable of quick action by virtue of overindulgence in alcohol, an automobile becomes a lethal weapon. During the year 1948, some 39,584 persons were arrested for driving while intoxicated. Since the overindulgence in alcoholic beverages is still primarily a masculine prerogative, the majority of such arrests comprised men, with 37,925 males and 1,659 females involved.[23] While many such persons were behind the wheels of their automobiles, the adjacent highways and city streets became dangerous places for the sober citizens to indulge their propensities for independent locomotion.

The mobility of America is proverbial. A considerable part of this mobility arises through the widespread ownership of the automobile and the highways built to accommodate it. Under certain conditions (the depression years) mobility has been defined as a symptom of a disordered society and hence as a social problem. Under certain other conditions (the defense and war periods) a restless and mobile America has been viewed as virile and resourceful, able to cope with any emergency. Whether under conditions of depression or total mobilization, however, there are other patterns of behavior closely related to the automobile and the highway that are considered inimical to social values and hence social problems. Extra-marital (and non-commercial) sex relations, prostitution, and certain forms of criminal behavior constitute some of these patterns. Accidental death on the highway (exclusive of manslaughter by negligence) threatens other social values. The instability of the family arising from extreme mobility is likewise a social problem. Such institutions as the church, the school, and the agencies of local government undergo a decline in influence in a mobile society. Other community influences are similarly weakened. Any solution to these problems of mobility presents other difficulties, arising from powerful social values. A nation that believes so fervently in individual freedom will hesitate to endanger this basic value by serious interference with social mobility, even though other problems may arise in its wake.

[23] *op. cit.,* 113, Table 44.

12 THE HIGHWAY IN URBAN AND SUBURBAN AREAS

BY JOSEPH BARNETT

URBAN SOCIAL CHANGES IN THE MOTOR AGE

THE development of the motor vehicle and the parallel improvement of roads and streets provided most urban and suburban residents with ready means for getting to places quickly, and provided commerce and industry with time-saving and economical transportation of goods. Social changes caused thereby were important and far-reaching. The character of many streets was changed and life along them assumed different aspects. Populations shifted and the character of land use changed with the change in character of street use. Commerce and industry found many problems solved by the motor vehicle, new problems evolved, and changes in location and methods were found desirable. Frequently the city and the relation between urban and suburban areas underwent appreciable change.

Prior to the motor age the city street performed many functions which have disappeared or been reduced, and some which they now perform were not anticipated. The street served its intended purposes well enough. Goods were delivered. People reached their homes. The homes were served with the necessary utilities which used the streets to connect them with the sources of the services. But the street also served other functions of a social nature. It was a leisurely meeting place for neighbors and a playground for children. Life on streets was not particularly hazardous except when frightened horses ran away. Neighborhoods retained their identity because travel of appreciable distance was time-consuming and difficult. People remained at home and looked to their neighbors and the neighborhood for the simple pleasures of life.

The motor age brought with it many changes in living on a city street. The speed of traffic now is far from leisurely and the number of vehicles so great that playing on the street is hazardous and without fun. Substitutes had to be found. Reservations for parks and playgrounds had in former years been considered practicable in large areas only. We now know that the city park or playground used most intensely is that in the neighborhood, literally in one's

back yard. Schools and their grounds which used to be closed in the summer had to be opened as summer meeting places and playground areas. For many people the leisurely walk to market was replaced by the telephone and light delivery truck until the war and accompanying shortages of goods and service help swung our habits to self-service stores and delivery by the buyer in his own automobile or, in densely populated cities, in his own go-cart.

Vacation habits have undergone many changes due to the motor vehicle. Most vacations used to consist of a stay at a seashore or mountain resort for the customary week or two. Now the vacation trip in the family car has become an established custom and motor courts or equivalent dot the landscape. This does not imply that the old-fashioned vacation is a thing of the past. Resorts have increased in number and are patronized more than ever. This is primarily due to an ever higher standard of living which permits more people to take vacations and increase their length. But the motor vehicle has shortened the time and increased the pleasure of travel between cities and resorts, and the average travel distance for non-touring vacationists has steadily grown. The resort which, in the past, was considered a proper distance for the annual vacation is now just right for a week end. Travel to resorts by motor vehicle is not confined to car owners. Buses now carry more people on such trips than trains and an interesting new plan of public transit has developed. By it a telephone call arranges for door-to-door transportation by private car, shared with others of course. In New York the plan results in cheaper, more pleasant, and less time-consuming transportation directly to and from resort facilities.

The delivery of goods to commercial and industrial establishments has also undergone change but of a somewhat different nature. Rarely had the driver of a horse-drawn truck to worry about a convenient place to stop to load or unload. In the motor age the scramble for a place at the curb has become so fierce that trucking companies have been known to use empty trucks for the sole purpose of reserving loading space along the curb.

PHYSICAL CHANGES

While many streets of our cities have undergone change in character of use, they have not been changed physically except for occasional widening within the limits of existing right of way. The taking of right of way to adequate width has required courage of a high order and funds in quantity, both of which have generally been lacking. The need for wider streets is greatest along arterial routes which are zoned and used for commercial enterprises so that the

cost of right of way for widening is greater than on other streets. In cases where the many obstacles to widening have been overcome, relief has been forthcoming, but it has proved to be only partial and temporary because the conflicts with roadside commerce and traffic on cross streets have remained. Traffic could not flow freely, and only a moderate increase in the number of vehicles soon overtaxed the facility.

In rural and suburban areas it was not expensive or difficult to widen approach roads. In most cases the state highway organization was empowered to expend funds on the approaches to cities but not in cities. These factors and many more resulted in an unbalance of arterial highway facilities. They were developed to reasonably adequate standards between cities but remained wholly inadequate through cities.

Unbalance also developed in terminal facilities. The resident in a city found it more difficult and expensive to own a family car than the rural or suburban resident. Garaging in cities was more expensive, insurance rates were higher, ability to reach a destination more difficult than in rural areas, and upon arrival at a destination in a city the problem of parking had to be faced. On the other hand a garage or car park could easily be added to a suburban home and little delay was experienced in reaching an arterial route. Industrial establishments also found it easier to provide terminal facilities in rural or suburban areas than in cities. Space in quantity is needed for docking, loading, and storing of goods.

The trend toward decentralization experienced by many cities was due to many causes, some of complex nature. While there may be difference of opinion as to the relative importance of these causes, there is little doubt that automotive transportation was a most significant contributor. With home life along city streets gradually deteriorating, people moved to the suburbs where land was cheaper, building laws less restrictive, and taxes lower. It is useless to point out that some of these decreased costs were imaginary; that pavements, sewers, and good water had to be paid for eventually; that lower cost for services meant less services. The urge to live in pleasant surroundings can overcome many obstacles. When combined with the drug of apparent lower cost it is overpowering. The places of migrants from cities to suburbs were taken by lower income groups resulting in a progressive deterioration of old neighborhoods, particularly near commercial and industrial areas.

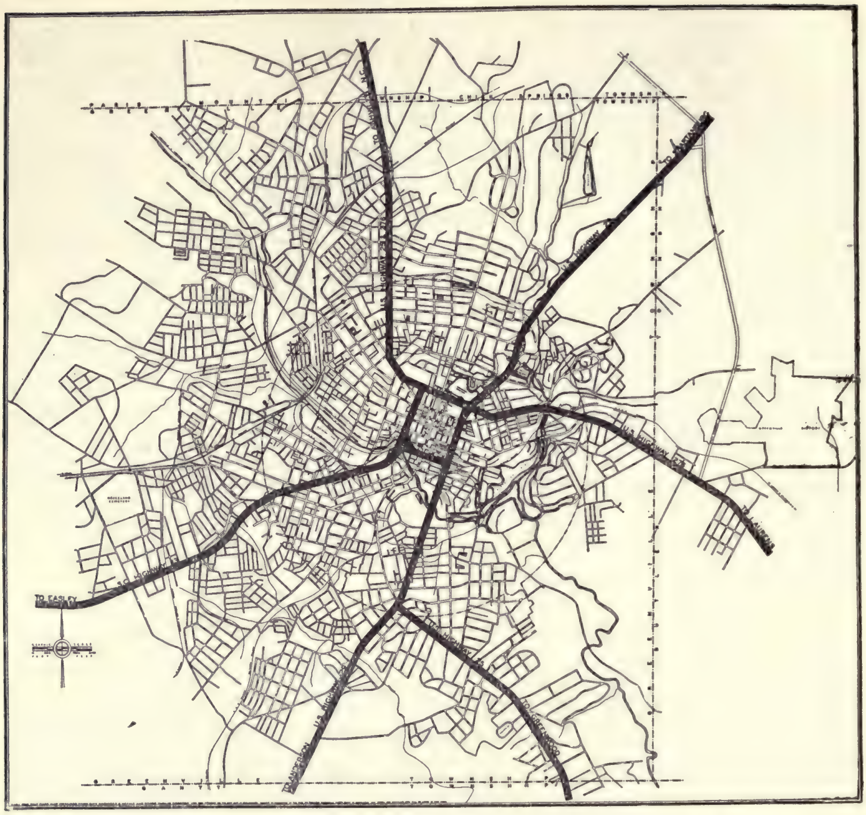
Most cities present the pattern of a central business or commercial district, an adjacent ring of dilapidated old buildings, generally

old residences (either converted to commercial use or allowed to run down to substandard housing), a surrounding area of medium-grade or high-class housing of more than average density, and a creeping or fingerlike development—new, heterogeneous, and uncontrolled—along the radial routes leading out of the city. Adjacent to or between the radial routes are developed areas. Some are residential areas with local shopping centers. Others are commercial or industrial developments. They are not clearly defined, generally merging one with another unless otherwise planned.

In most instances the radial routes present a picture that is far from pretty. Unrestricted development along the roadsides has made approaches to cities via highways as unattractive as entrances via railroads. Instead of the industrial development that borders the railroads, the highways are fringed by a conglomeration of roadside businesses which, with their varied and blatant signs, vie with one another for the attention of travelers, detract from the sightliness of the city's gateway, and constitute a positive detriment to efficient highway transportation.

THE PATTERN OF NEEDED ARTERIAL ROUTES

The art of obtaining facts about people and their habits and desires by canvassing representative groups has advanced to a stage where we now can make such surveys with assurance of obtaining reasonably accurate data. Using these methods we can trace a pattern of desires regarding travel that leaves little doubt regarding the facilities which should be provided. In satisfying the needs of motor vehicle traffic there should be roads to connect the farms and other rural facilities with nearby municipalities, a network of roads connecting all cities of any importance with one another, free-flowing facilities between suburbs and their urban centers, and a network of free-flowing arteries and distributor streets which will serve all intra-city traffic as well as that traveling to and from the cities. When data for travel in and near cities are analyzed they inevitably lead to the conclusion that, to serve traffic best, arterial routes should be located so that the through routes outside the city are connected with the central business district. Practical considerations, such as the high cost of property in the heart of the central business district, require that the lines be located a few blocks therefrom in the fringe areas that are so common in many cities. In these areas, buildings have been allowed to deteriorate because no agency existed to control city development. Many years ago when additional housing was being constructed these areas could not compete with the less expensive land surrounding them be-



Typical Pattern of Urban Arterial Routes as Illustrated by the City of Greenville, South Carolina

cause their proximity to business made the land potentially valuable, although the time for conversion to business had not yet arrived. The houses in these areas could be rented as dwellings to low-income groups or to some types of businesses, and so could pay the carrying charges while the owners waited for commercial expansion to absorb them. There usually has been no incentive to maintain the houses in good condition.

When the routes leading to the central business district are connected along these fringes, the pattern of needed travel routes takes shape. In the larger cities, it consists of a close-in circumferential route from which arterial roads to the outskirts of the city, and beyond, radiate in several directions. The pattern may twist, bulge, or be cut off on one or more sides; the inner circumferential route may be round, square, or elongated; the radial routes may be

somewhat indirect; and a large body of water or other topographic features may block radial roads in some directions—nevertheless, the pattern is apparent.

In large metropolitan areas another characteristic part of the pattern is the outer circumferential route and sometimes an intermediate circumferential route. These routes are useful and, in some cities, very necessary facilities for traffic between the outskirts or suburban areas and between points near different radial routes. They are not first-order priority projects, however, although sometimes considered first because of the relative ease with which the right of way can be acquired.

CONTROL OF ACCESS

The control or limitation of access is necessary to the proper functioning of a free-flowing expressway. Sometimes (particularly on new facilities) this can be obtained when purchasing the right of way, provided the laws of the state permit. Controlling the right of access is not a simple matter. The rights of citizens to enter a public highway are rooted deep in fundamental common law and are not easily withdrawn. The best course appears to be the purchase of these rights from the owners of adjacent property and the provision of frontage roads along both sides of the expressway to serve abutting property. Frontage roads intersect all streets and driveways and form, in effect, part of the street system. Only thus can arterial routes be protected from the undesirable features of a continuous development of objectionable businesses along the roadsides. This unsightly type of ribbon development not only reduces the capacity of the arterial route and increases the hazard of travel thereon; it also has an adverse effect on adjacent land areas. How different the protected, properly landscaped roadsides which act as insulation between the movement on the highway and the immobile use of the adjacent land.

SOCIAL EFFECTS OF THE PATTERN

Social betterment is one of the objectives of enlightened city planning. Most city planners agree that zoning, closely knit neighborhoods, and urban redevelopment are some of the broad ideas that will help attain this end. It is not my task to discuss these subjects but their relation to the location of free flowing arterial routes is important. These routes are best located when, in addition to satisfying the fundamental needs of traffic, they divide one neighborhood from another, particularly those of different character. A neighborhood presumably is self-contained and satisfies the every-

day needs of its occupants, but the central and other business districts must be easily accessible for the wage earner, the businessman, and the shopper of more than the day to day necessities. If arterial routes are reasonably close to both the neighborhoods and the central business districts, access between them will be easy and one of the factors in the rehabilitation of the high-value downtown areas of our cities will have been supplied; it may, indeed, be a very powerful factor.

Developments which are designed to satisfy the wants of people, commerce, and industry tend to larger and larger units. Apparently there is economy in bigness or the trend would not be so marked. Fortunately bigness carries with it the opportunity for better things. Garden-type housing projects on large tracts are better places in which to live than individual apartment houses or even separate homes in some real estate ventures designed for quick profits. Urban redevelopment combined with housing for middle-income and low-income families can go a long way in reducing the blight of many cities. There are numerous examples, one of which is Stuyvesant Town in New York, financed by the Metropolitan Life Insurance Company to accommodate 8,800 families. Commercial establishments also tend toward larger units. The small individual store is giving way to groups of stores which complement each other and join in many services such as parking areas for customers. The "park and shop" is becoming common and the retail sales buildings of the mail order companies are assuming huge proportions. Radio City in New York is another example of a huge self-contained commercial and business venture. Many industrial establishments also have become very large. The small factory is giving way to the immense establishment which proved so efficient during the development of the automobile and later during the war.

These large establishments cannot function properly without adequate transportation to serve them. While railroads, airlines, and ship lines are necessary for some, the means needed for most is motor transportation. Thus the planning of large housing, commercial, and industrial establishments must go hand in hand with the planning of arterial routes.

It is visionary to believe that free-flowing arterial routes alone will solve all our city transportation problems. Only a limited number can be justified in a city and existing streets will have to take some of the burden. In our larger cities transit facilities with their great capacity in number of riders per unit will prove to be vitally necessary. Existing streets will also have to act as distributors and

collectors because each person or bundle of goods has as an ultimate destination a building or other facility along a street.

THE TERMINAL PROBLEM

The solution or non-solution of the terminal problem can have a profound effect on the social life of a community. It is not sufficient to provide free-flowing arteries between neighborhoods and other areas of varying characteristics and functions. It is not sufficient even if these are supplemented by improved distributor streets. Each motor vehicle has one or more destinations for depositing people or goods, and most vehicles have to be stored for periods ranging from a few minutes to several hours. Unless it is convenient to load and unload, and unless space is provided for storage of vehicles, many businesses will find it convenient and necessary to desert the central business district for outlying areas or at least provide branch establishments there. The decentralizing trend of commerce and industry has been strong not only because land in the suburbs is cheaper. In many cases the change in location is compelled by the need for providing facilities, such as parking and loading areas, peculiar to the motor age, facilities which could not be provided easily at the central location.

Neighborhood shopping centers were developed to satisfy only the day-to-day needs of the community. They generally consisted of a butcher, a baker, and a candlestick maker or, in its modern version, the 5 and 10 cent store. The larger department stores, clothiers, hardware stores, banks, theaters—all the different types of businesses which go to make up the central areas of our cities—should remain downtown. They would and will if the arteries and terminals of traffic are freed. They will not if the cities fail to accomplish the freeing of this traffic, and decentralization will continue at an accelerated rate.

That phase of the terminal problem called parking is on everyone's lips and is receiving most attention. Annoyance is a powerful whip and public officials hear often from citizens when the latter are required to cruise in search of places to leave their vehicles. Such cruising is not only annoying and costly to the driver; in many cases it adds unnecessary volume to loaded streets and by its nature of operation forms a serious hindrance to smooth operation thereby reducing the capacity of the street. Most off-street parking facilities in the form of parking lots, parking buildings and garages have, thus far, been provided by private capital. Parking areas for retail and other businesses, singly or as joint ventures, are appearing in increasing numbers. Many parking lots cannot be considered per-

manent. Owners of land of high value cannot be expected to resist the economic pressure of greater return by more intensive use of the land by the construction of buildings. Providing buildings on parking lots adds to the traffic load and reduces the space available for storage, both factors increasing congestion.

Provision for parking by public and quasi-public agencies is being made to an increasing degree. Sometimes taxes are necessary for financing. Such taxes may take the form of interest on bond issues, assessments on land and improvements in affected areas or fees charged to benefited businesses in proportion to customer use. In some cases the public agency may be little more than a means toward consummating the project which is self supported by parking fees.

The delivery of goods has its own characteristic problem quite different from the parking of passenger vehicles. Delays in approaching buildings or other business establishments and in loading or unloading are costly. In addition, trucks occupy large street areas and can seriously hinder traffic flow, particularly while maneuvering into position. Some establishments have provided off-street docks for trucks thereby reducing delays and the cost of handling goods, but on most city streets sidewalk loading is the order. An interesting development to improve truck delivery service is the union truck terminal where goods brought in long-haul large units are rehandled to smaller units in which goods from several sources are collected to be delivered to one destination. This reduces the vehicle miles of travel on city streets, such travel is done in smaller units, and the number of stops is reduced. These economies pay, presumably, for the cost of rehandling at the terminal and give a superior delivery service in addition to reducing congestion on the city streets.

A long-range effort to relieve terminal congestion is the use of zoning regulations which require improvements hereafter to be made with adequate provision for off-street facilities for loading and the storage of vehicles. These, when properly drawn so that requirements fit needs realistically, and when strictly enforced, should go a long way in providing new developments which can benefit fully from the use of motor vehicle transportation. But what about areas not likely to be rebuilt for many years, if at all—the congested streets which must be used now, the cities we have to live with and in for the rest of our lives? Are these to be deprived of the blessings resulting from the development of the motor vehicle? Are we to allow important centers to continue to deteriorate? Why could not the police powers of the state be used to compel the owners of

existing structures to alter them or otherwise provide off-street loading and parking facilities? Are not the police powers exercised for the consideration of the public health, safety, or welfare? And is not increasing congestion tending to affect adversely public health, safety, and welfare by its throttling of the arteries of motor vehicle transportation?

The numerous projects planned, under way, and completed for the relief of terminal congestion appear all to be worth while. They should help materially in solving the vexing terminal problem. Yet they are palliatives and not cures. Not until we attempt the bold approach of requiring existing structures to be altered for off-street loading and requiring owners to provide off-street parking will we be sure of doing all we can.

13 THE FUSION OF URBAN AND RURAL

BY WALTER FIREY, CHARLES P. LOOMIS, AND J. ALLAN BEEGLE

THE HIGHWAY AS A FIELD-CENTER NEXUS

HUMAN activities, when viewed in terms of their geographical layout, are of two kinds: "field" activities and "center" activities.[1] The former are directed toward wresting from the land the foods, fibers, ores, and raw materials upon which sustenance depends. The settlements and communities which grow up around these "field" activities, being relatively small and dispersed in character, are generally classed as *rural.* "Center" activities on the other hand, have to do with the processing, distributing, and coordination of field products. Their performance requires great agglomerations of people within rather restricted areas of space. Thus there emerge communities which are commonly called *urban.*

Between the field and the center—between rural and urban—there is an incessant concourse of people and commodities. The channels along which this concourse flows are the roadways of society: the rutted trails, the dirt-and-gravel roads, and the paved highways, all supplemented by the long distance waterways and railroad tracks.

The extent of field-center concourse will, naturally, vary directly with the character of the roadways which connect field with center.[2] Roadways, in other words, are the nexus between rural and urban. Few and poor roadways mean impeded interaction; they involve a sharp distinction between rural and urban. Many and good roadways mean facilitated interaction; they entail a rapprochement between rural and urban. Precisely in this elemental fact lies the clue to the most important processes now under way in rural and urban community formation. Briefly, urban is becoming less urban, rural is becoming less rural.[3] The distinctness of field from center is rapidly being obliterated.

The causative factor in this trend, which is so radically altering the settlement structure and community organization of the Ameri-

[1] R. D. McKenzie, *The Metropolitan Community* (New York, 1933), 50-65.

[2] cf. *loc. cit.*

[3] Pitirim A. Sorokin, Carle C. Zimmerman, and Charles J. Galpin, *A Systematic Source Book in Rural Sociology* (Minneapolis, 1932), III, 639.

can continent, has been the evolution of the roadway system. The highway is the latest type of roadway to have influenced significantly American settlement patterns and community life. Prior to it, in the waterway era and in the railroad era,[4] the city was in very large degree autonomous of its own rural hinterland. One who journeyed from the center of a metropolis outward would always encounter an abrupt, precipitous transition to unspoiled countryside. Socially and culturally the transition was just as abrupt. The city was truly a state of mind; the country was another and very different state of mind.[5] Between them there was an abyss. During the water era New Orleans was literally closer to Memphis than it was to its own rural Louisiana hinterland. Likewise, during the railroad era, Cheyenne was nearer Chicago than it was to nearby rural hamlets which had been stranded by the railroads' passing a few miles away.

But the highway has changed all of this. Because of the peculiar superiority of the automobile as a short-distance, small-load carrier and as a "free agent" whose course and destination need not be confined by waterways or railroad tracks, the advent of highway transportation has meant, for the first time, intimate contact between a city and its hinterland. Rural and urban have truly met. The rapid extension of highways and of automobile ownership has now carried the process so far that "field" and "center" are almost fusing. The consequences of this for settlement patterns, social interaction, and cultural relations cannot be overestimated; they are all-important.

THE INFLUENCE OF THE HIGHWAY UPON RURAL SETTLEMENT PATTERNS

Four main alterations in rural settlement patterns have followed from the proliferation of highways between "center" and "field": (1) the emergence of fringe areas on the outskirts of cities—areas that are half rural and half urban in their characteristics;[6] (2) the appearance of string-along-the-road settlement patterns involving both country-dwelling city people and rural farmers who are interested in accessibility to markets;[7] (3) the development of service areas surrounding towns and cities, generally greater in extent than

[4] McKenzie, *op. cit.*, 129-143.

[5] Howard Woolston, *Metropolis* (New York, 1938), 4.

[6] Louis A. Wolfanger, *Your Community and Township Zoning*, Michigan State College, Agricultural Experiment Station, Circular Bulletin 184, (East Lansing, 1945), 12-13.

[7] See *ibid.*, fig. 3 and *passim*.

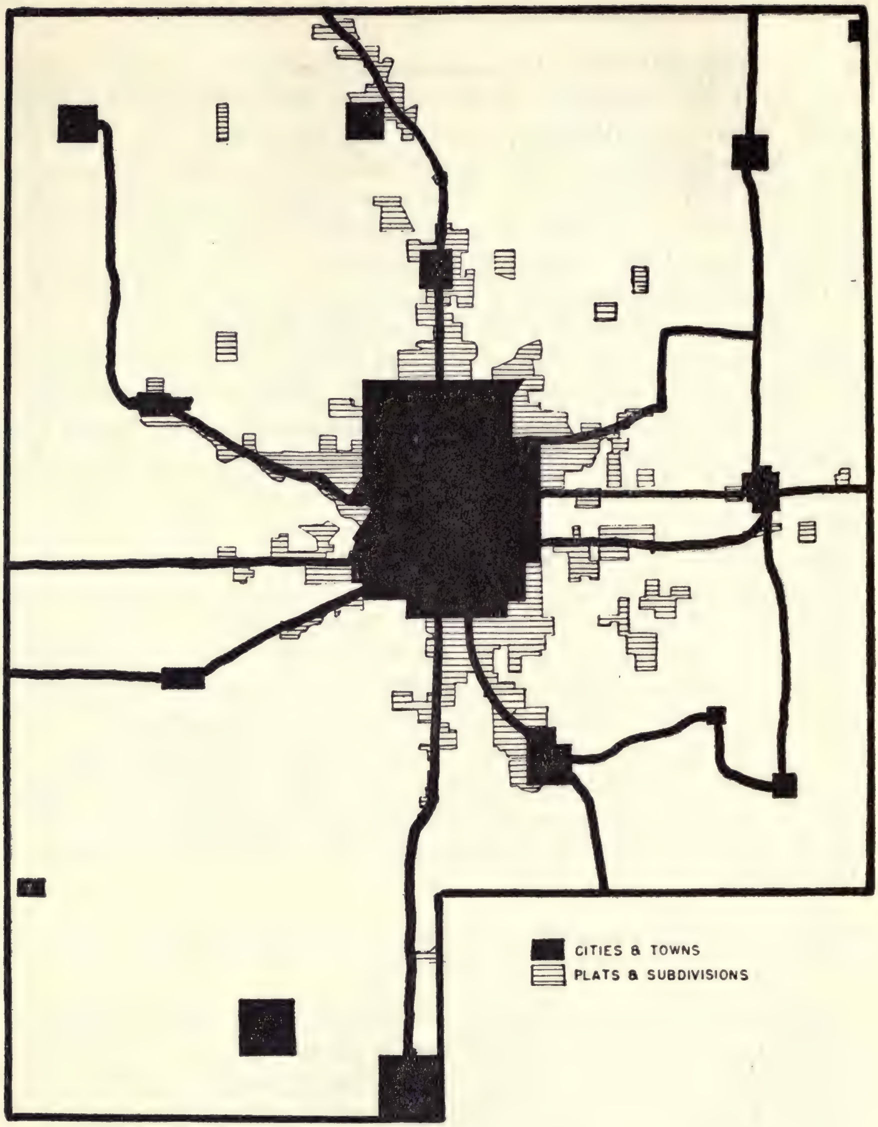


FIG. 1. THE STAR-LIKE CONFIGURATION

The star-like configuration and the string-along-the-road patterns are well shown in the case of Flint, Michigan. The ease of communication afforded by the highways coupled with numerous other factors fosters settlement along the roadways. This leads to the development of the "fringe." In 1940, the incorporated population of Flint numbered 151,543, but the "rural" people who resided in four townships adjacent to Flint numbered 28,641. This number represents the nonvillage rural-nonfarm group, or those persons who live outside of cities or villages and do not farm. This "fringe" population is located for the most part on the highways outside Flint's boundaries, and if added to the incorporated population of Flint would account for 1 out of every 6 persons in the area.

the "fringe" and differing in certain functional respects as well;[8] (4) the formation of satellite sub-centers, out beyond the central service area, each with their miniature fringes, strings-along-the road, and service areas.[9] All four of these developments may be visualized as aspects of a single process: that of nucleation and sub-nucleation. Briefly, highways are binding the field areas into organic, functioning unities and sub-unities which surround and tie in with centers and sub-centers. Villages serve as centers for little fields; towns are centers for larger fields; and cities function as centers for the largest fields. Each field, with its center, is successively subsumed into the next larger one, in hierarchical fashion.

Thus there emerges a functional pyramid of field-center "organisms," all bound together by a network of highways. The height of the pyramid and the degree of its functional unity is directly contingent upon the number and layout of its sustaining highways. A steep and highly integrated pyramid of field-center areas constitutes a highly "rurbanized" region, to use an accepted sociological neologism. Such a pyramid implies intimate interaction between rural and urban people, a reduction of their differences, a fusion of their interests. In spatial terms it is manifest by relatively dense agglomerations of population surrounding a city, typically assuming a star-like configuration with apices reaching outward along the main highways. Beyond these are sub-centers of population, each with their lesser apices reaching out. Thus emerge the fringe and string-along-the-road patterns so typical of the rural areas lying just outside American cities. See Figure 1. In between these centers and sub-centers, as well as out beyond them, in the areas more truly rural, are farm families whose new proximity to the city, made possible by the highway, renders them a little less rural and a little more urban than they had been before. The outer limits of such service areas may be ascertained by minimal traffic counts along outgoing highways, by boundaries of department store deliveries, by the furthermost extent of shopping, or even by the direction which tire tracks take on the dusty roads that run into arterial highways.[10]

[8] See Calvin F. Schmid, *Social Saga of Two Cities* (Minneapolis, 1937), 90.

[9] See Noel P. Gist and L. A. Halbert, *Urban Society* (New York, 1946), 2d ed., 171, fig. 9, reprinted from the *Chicago Tribune*.

[10] On the techniques of delineating service areas and neighborhoods see: Irwin T. Sanders and Douglas Ensminger, *Alabama Rural Communities: a Study of Chilton County*, Bulletin, Alabama College, Vol. 33, No. 1A, (Montevallo, 1940), 72-80. On the administrative value of these techniques see: Charles P. Loomis and Douglas Ensminger, "Governmental Administration and

The method of delineating trade center communities is illustrated in Figure 2. The average flow of traffic over a 24-hour period has been recorded by the Michigan State Highway Department for nearly all roads in the state. A record of these counts has been made on the chart for a typical market center and typical small neighborhood, Howell and Hartland. It will be noted that the flow of traffic

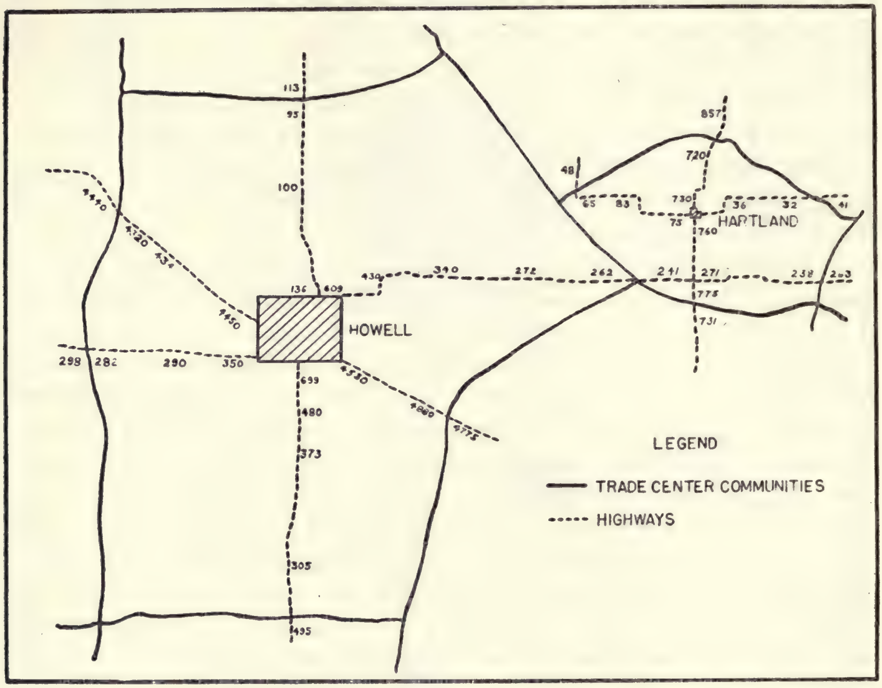


FIG. 2. TRADE-CENTER COMMUNITIES

The trade center communities of Howell and Hartland, Michigan, delineated from traffic-flow readings. Note that the community boundaries fall at the minima points on out-going highways. In 1940, Howell's population was 3,748 and that of Hartland township, in which the village is located, only 733. See footnote 11 for other details.

increases as one moves into each of these centers. At some point on each of the roadways, however, the volume of traffic reaches a minimum and then increases as one moves into another urban center. These points of lowest traffic volume represent the outer boundary

Informal Local Groups," *Applied Anthropology,* (January-March, 1942), I, 41-59, reprinted in Loomis, *Studies of Rural Social Organization in the United States, Latin America and Germany,* (East Lansing, Michigan, 1945), 151-172. See too: F. Howard Forsyth, "The Use of Road Turnings in Community Research," *Rural Sociology,* (December, 1944), IX, 384-385.

of the trade center community. A line connecting all such minima traffic flow points around a given center may be considered as forming the generalized boundaries of a trading area.

Ordinarily, the frequency of trips to a center is a function of the distance. That is, the nearer the center, the more frequently people will visit it, other things being equal. However, if the nearest place is a neighborhood center, complete services will not be available. Thus trips to larger centers are essential. The area serviced, or the traffic attraction power of the Hartland neighborhood center and the Howell market center, as shown in Figure 2, is vastly different.[11]

It will be noted from Figure 2 that the contours of the Howell market center are rectangular in form, a characteristic of many communities throughout the Middle West. In all probability, this form may be attributed to the rectangular or "checkerboard" system of land division which typifies most of the Middle and Far West. In this rectangular system, roads generally run parallel to the longitudinal and latitudinal land division lines. Since diagonal routes to a center rarely exist, the resulting trade center contours tend to be rectangular. For this reason, it may be necessary to supplement the traffic-flow readings with personal interviews in order to establish certain of the community boundaries. This applies especially to areas comparable to the southwest and northwest corners of the Howell community, Figure 2. Regardless of the pattern that the areas of influence of the emerging centers and sub-centers take, the consequence of all these changes has been a "polarizing" of population along the highways, much as iron filings polarize around a magnet. Such polarization is a very tangible thing which is strikingly apparent in the geographical layout of dwellings and outbuildings as seen from the air. It should not be inferred, however, that such population realignments spell the end of small communities—the last harbingers of the rural component in rurbanization. Highways have indeed more fully bound the small community to the large community; they have in many cases led to the demise of some villages and the nascence of other villages. But the small

[11] See J. F. Thaden, *The Lansing Region and Its Tributary Town-Country Communities,* Michigan State College Agricultural Experiment Station Special Bulletin 302, (East Lansing, 1945), 27-30. Thaden's study shows that the Howell community center contains three banks, has a newspaper circulation of 3,892, and has a high school enrollment of 429. In comparison, the Hartland neighborhood center has no bank or newspaper, and has a high school enrollment of only 150. Population estimates for 1940 show that the Howell trade center area includes 8,670 persons, 57 per cent of whom reside in the tributary area; the Hartland neighborhood contained 509 persons, 61 per cent of whom resided in the tributary area.

community—the sub-center, as it were—is no less functionally necessary today than it was in the past. Without it the field-center pyramids that have evolved around highway systems would become all apex and no base—monstrously unstable structures that could not function economically or socially.

Conclusive evidence of the continued significance of small communities may be found in areas whose settlement has taken place almost wholly since the advent of the automobile and the highway. Saskatchewan is one such area. There it was found that the number and vitality of small rural communities was fully as great as in areas whose settlement had antedated the highway era.[12] The grounds for this fact lie in the indispensability of the sub-center, with its sub-field, as a constituent, functioning "organism" within the more inclusive orbit of the super-center and its super-field.[13]

THE INFLUENCE OF THE HIGHWAY UPON RURAL SOCIAL INTERACTION

Such realignments of rural settlement patterns as these cannot help but entail corollary changes in rural social interaction. Highways have exerted both an organizing and a disorganizing effect upon rural group life. On the one hand they have broken down the seclusion and provincialism that once characterized rural life. Now more than ever before the farm family can participate in "the larger society" which is borne by metropolitan newspapers, urban recreational facilities, urban libraries and schools, and many other points of contact unknown to the nineteenth century country dweller. Organizations and activities once the prerogative of the urbanite are now just as accessible to the ruralite. Aristotle's sly plan to disfranchise the peasantry by stipulating frequent and regular participation in the city assembly as a prerequisite to citizenship—an impossible thing for farmers in an era of donkey-path transportation—would never work in a modern rurbanized society. Farmers now can get to the court house about as easily as the townspeople. Such enlarged areas of contact of course mean enhanced political and economic power of farmers—so long a traditionally disadvantaged segment of the American population. Highways, in short, have made the rural population more cosmopolitan.

On the debit side, highways have disrupted the stable localistic

[12] Carle C. Zimmerman, *The Changing Community* (New York, 1938), Ch. 2.

[13] See D. G. Marshall, "Hamlets and Villages in the United States: their Place in the American Way of Life," *American Sociological Review,* (April, 1946), XI, 159-165.

groupings that have been the bedrock of America's rural life. Distinctive neighborhood institutions—the church, the lodge, the country schoolhouse—these have been succumbing before the competition offered by their urban equivalents. Whatever the gain may be, it has certainly been matched by a real social loss. For these old-time localistic institutions, with their typically intimate, face-to-face associations, were potent citizen-building forces. The consolidated school, the federated church, the urban lodge—whatever their advantages, they can never quite replace their rural predecessors. Family life itself is changing. The individualization of activities, long so typical of urban family life, is manifesting itself in rural families as well. In place of family picnics, family reunions, and family church-going there is a splitting apart of activities, in which father goes to the lodge meeting, mother attends the church missionary society meeting, daughter goes to the high school dance, and junior takes in a movie.[14] Traditionalized domestic roles are themselves breaking down under the impact of "equalitarian" family ideals conveyed via the movie, the newspaper, and other concomitants of improved rural-urban transportation.[15]

THE INFLUENCE OF THE HIGHWAY UPON RURAL CULTURE

Such changes, of course, are a reflection of changed values, changed ideals, changed standards—in short, of a changed culture. In this respect the highway has functioned as an artery, bearing outward along its course new values, ideals, and standards. While communication is always a two-way process, by and large most of the diffusion of new cultural patterns has been one-way. Urban patterns are being borne out along the highways into rural areas to a much greater degree than rural patterns are being borne inward toward the cities. Indeed it is possible, by means of maps, to delineate with remarkable precision the gradients which urban cultural patterns take on in the rural areas contiguous to a city. Data on birth rates, on delinquency, on subscription to daily newspapers, on living levels, and on many other significant items show more or less typical concentric tiers surrounding a central city, each tier revealing successively less urban acculturation as one goes outward from the city.

[14] On the remarkable persistence, however, of whole-family activities among rural people, see: W. A. Anderson, "The Family and Individual Social Participation," *American Sociological Review,* (August, 1943), VIII, 420 ff. and (December, 1943), VIII, 721 ff.

[15] Ernest W. Burgess and Harvey J. Locke, *The Family* (New York, 1945), 92-110.

Research conducted by the Planning and Traffic Division of the Michigan State Highway Department [16] indicates that the flow of traffic is inextricably related to socio-economic factors. In conjunction with such factors, some 1,341 places have been classified. For 416 of the larger centers, the following socio-economic indices were used: (1) the population of the immediate trade area (this includes the population of the center and surrounding area that is dependent upon the center for a majority of its everyday requirements and services); (2) total bank resources; (3) newspaper circulation; and (4) the equalized valuation of a center. Some 1,306 places were classified in accordance with their traffic-attraction characteristics. A determination of the trip frequency by distance relationship for each destination permitted segregation of these places into groups according to their relative traffic-attraction importance. The correlation coefficient between the ratings established by the socio-economic indices and those established by traffic-attraction indices as resulting from a correlation study of 381 places for which both the socio-economic and traffic attraction indices were available is .85.[17]

In respect to ability to attract traffic, centers in Michigan classified as indicated above fall into the following categories: (1) neighborhood centers, or small retail outlets which offer some of the requirements of the immediate surrounding area; (2) minor market centers or those which offer services usually sufficient to meet the general requirements of the center and its trade area; (3) complete market service center, or those offering services usually sufficient to meet the general requirements (including some recreational and cultural advantages) of the center and its trade

[16] For the maps and statistical basis for this discussion of trade center communities delineated from traffic flow figures, the classification of centers, and the relationships between various indices and the power of centers to attract traffic, we are indebted to officials of the Michigan State Highway Department. Pioneering research is being conducted by the Michigan Highway officials, especially John D. Cruise, Assistant Director of Planning and Traffic, Albert C. Sherman, Highway Planning Engineer, and Earl Fohl, Statistician.

[17] Certain of the places used in the correlation study are intense resort and recreational centers. This type of center is extremely difficult to classify using the socio-economic indices. A correlation of the socio-economic ratings and the traffic attraction ratings omitting the resort and recreational centers gave a much higher correlation coefficient. It is known that retail sales is another index of great importance in indicating the traffic attraction power of a center. At the time this study was made, however, complete data were not available, especially for the lesser populated places. Correlation studies relating traffic attraction power of centers and various socio-economic and demographic factors are being made by the Social Research Service of Michigan State College.

area; (4) regional center, or places which offer complete market services sufficient not only to meet the needs of its community and trade area but also to serve as a principal wholesale distributing center; and (5) metropolitan center, or centers which not only offer complete market services sufficient to meet the needs of the trade area but also those which serve as major trade centers in the national economic structure.

Making due allowance for some exceptions and for some degree of variability in the centers, the general principle still seems to hold that rural areas, in direct proportion to their proximity to urban centers, are becoming culturally urbanized. Since proximity is contingent upon time-cost accessibility between country and city, itself a function of highways, the causative agent in this urbanization of rural culture must be evident. It is the highway that has brought city values, ideals, and standards to the country dweller. Notions about life objectives, about loyalties, about modes of living, about consumption tastes, about well-being—all of these are becoming more alike as between country and city. While all this perforce means the loss of quaint, rustic ruralisms, it means, too, the fuller integration of the American people around basic and historic ideals of the nation. More truly than ever before a homogeneous, internally consistent, and universally accepted value system, shared alike by urbanite and ruralite, is coming to characterize American society. The role of the highway in effecting this cultural rapprochement between country and city has been decisive.

14 THE HIGHWAY AND THE CANADIAN BORDER

BY A. S. MATHERS

OVER four centuries ago Jacques Cartier discovered the St. Lawrence and claimed the country on its banks for the King of France. Frontenac and Champlain and a score of others in the century that followed explored and planted the Cross and the Lily Flag over a vast New France that from Gaspé reached westward beyond the Mississippi and extended from Hudson's Bay to the Gulf of Mexico. Incredible distances were covered in single summer seasons by such as La Vérendrye who from Montreal by way of the Ottawa and the northerly shore of Lake Superior reached the mouth of the Saskatchewan where it empties into Lake Winnipeg, and then turned southward to a point on the Missouri in North Dakota, leaving there a tablet claiming the country for France. Meantime the British occupied the narrow lands between the Atlantic coast and the Alleghenies which cut off the great western hinterland.

The facts of North American geography made it inevitable that the French should be the first to discover and know the magnitude and riches of the continent for they established themselves at the mouth of the only easy pathway from the Atlantic Ocean to the interior.

Along the banks of the St. Lawrence and its great tributaries, the Ottawa, the Richelieu, and St. Francis, they established their seigneuries in which the habitants' farms were narrow strips of land fronting on the rivers, rivers which floated their bateaux and canoes in summer and became highways for their sleighs in winter. Inland from the colony a vast network of streams and lakes made travel for explorer and trader a simple matter. Such roads as they built were either country lanes from the farms to the nearest seigneur's mill or town or a well trodden portage of the *coureurs de bois*. New France on the St. Lawrence was a river state; no passable roads connected its towns although a road of sorts ran along the northerly shore from Montreal to Quebec.

This was Canada when Wolfe and his army appeared before Quebec in 1759 and prepared the plan of battle that was to end the French Regime in North America. The peace treaty with France gave Britain this vast and undeveloped domain only sparsely settled in the valleys of the St. Lawrence and its tributaries, with the town of Montreal and the fortress city of Quebec the two foci of settle-

ment, its hinterland sprinkled with forts, but with hardly a single highway.

While the British are primarily a seafaring people they have never been a race of boatmen and the idea of depending upon small craft to move their troops rapidly from place to place in small detachments was out of the question. The danger threatening from New England at the approach of the American Revolution, coupled with a determination to hold Canada at all costs in case of war, led to an immediate and active program of preparation for the country's defence.

Forts were strengthened and enlarged; and where practical and strategically necessary, roads were built between them. The vulnerable route from New England was the Richelieu which drains Lake Champlain into the St. Lawrence at Sorel below Montreal. Fort Chambly and Fort St. John on the Richelieu guarded this approach to Montreal, from which a road to St. John became a busy highway as the preparations for war went on. It was the first real highway in Canada, short though it was, and it now forms an important section of the main road from Montreal to the American border at Rouses Point.

While at this period Nova Scotia was a separate British Colony and remained so until 1867, preparation for defense was carried on there as well. Halifax and Annapolis Royal were fortified ports but connected only by a long sea route around the southerly tip of the province. As a military measure a road was built across the waist of the peninsula to connect them, straight as a Roman road. That this road was ever used to any extent is very doubtful and it has long since disappeared.

After the War of the Revolution there was peace but little tranquility. Many Americans who had remained loyal to the Crown were dispossessed of their property and forced into exile. The high officers of state and church, and those whose wealth and family connections permitted them to do so, returned to Britain or went to the West Indies or to New Brunswick and Nova Scotia. The poorer of the Loyalists and those who had by virtue of long residence in America nowhere else to go, as well as the bulk of the men of the British Army who had been paid off after the surrender of Yorktown, trekked northward to Canada. Thousands of these dispossessed people arrived at Sorel and at Oswego and spent a miserable winter in hastily improvised camps.

The story of their privations and sufferings is not part of this story. Suffice it to say that eventually they received lands in the country west of Montreal and established themselves in what is

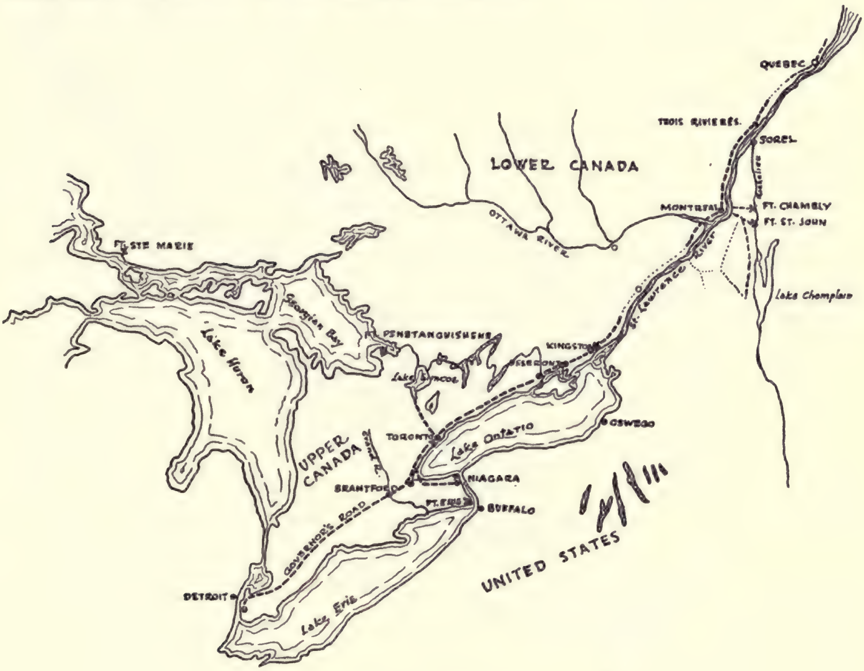
now the province of Ontario in settlements close by the forts at Niagara, Toronto, Kingston, and Prescott.

Included in this migration were the Indian people of the Six Nations Confederacy who had remained loyal throughout the war. To them were granted all the lands bordering the Grand River which rises in the high central plateau of Ontario and flows into Lake Erie between the Niagara and Long Point. The Mohawks were huddled in a camp at Niagara when news of the grant was brought by their Chief Thayendaneaga (Joseph Brant). At once a great division arose between them. The Senecas elected to stay in the United States and a party of Mohawks under their chief Deserontyou were determined to settle on the banks of the St. Lawrence.

The matter was amicably settled and the priceless communion silver from Queen Anne's Chapel of the Mohawks was divided. Deserontyou took his party and three pieces of silver to the lands he had selected on the shores of the Bay of Quinte near the present village of Deseronto. Brant, because of the numerical superiority of his followers, retained the Bible and walnut box and the rest of the silver and set off with his Indians for the Grand River. Crossing the Niagara they made their way on foot along the southerly shore of Lake Ontario and through the Dundas valley to the place he had chosen, which came first to be known as Brant's Ford and is now the city of Brantford. The trail became a beaten path as the Indians went back and forth to Niagara to trade. It was the first highway in Upper Canada and its route is approximately that followed by the present Queen Elizabeth Way.

The highway history of Lower Canada was repeated. Towns grew up around the isolated forts and farms spread out around them but all communication was by water. The fury of the Revolution had not died down and dire threats against the lives of the Loyalists were heard in news by travelers from the States. Fear and apprehension were as much a part of their daily lives as the back-breaking toil which they endured in hewing their homes from the forest. Anxious demands and entreaties to the Governor at Quebec for a safe and secure overland route from Niagara to Montreal were finally rewarded in 1793 when authority was given to build such a road; work on the westerly section of it from Kingston to Niagara was immediately undertaken. At the same time work started on the portage road from York (Toronto) to Lake Simcoe. These two roads were rushed to completion and were followed quickly by a road from the head of Lake Ontario westward to the Detroit River. These were essentially military roads and their purpose was to pro-

vide a system of interior lines of communication for the defense of the province in case traffic on the lakes should become interrupted. The Montreal-Niagara Road linked Fort Erie, and Fort George on the Niagara with Fort York at Toronto, and the fort at Kingston with Montreal. The portage road from York to Lake Simcoe provided a safe route northward to the inside water route to Fort Penetanguishene on Georgian Bay and to Sault Ste. Marie. The Governor's Road westward from Lake Ontario tied in Amherstburg on the Detroit River with the others.

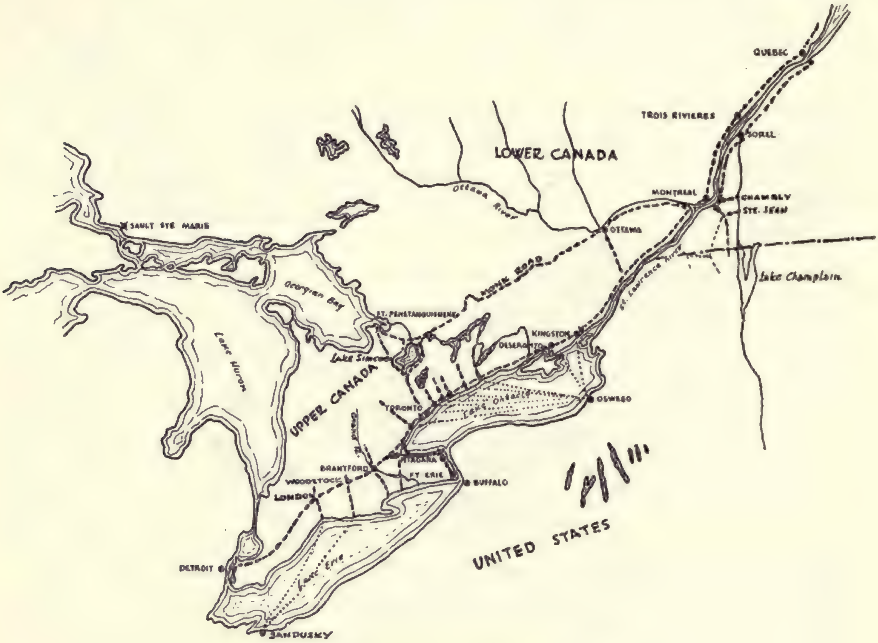


Highway Map of Canada, circa 1798

Strained relations with the United States during the Napoleonic Wars finally developed into war in 1812 and the military road system of Upper Canada had its first and only test, proving the military sagacity of its builders. Unlike the military road from Halifax to Annapolis Royal the military roads of Upper Canada suffered no decline but remained the backbone of the province's highway system. All are in use today, widened, straightened, and paved, constituting the main highways of the province.

Following the end of the War of 1812, Upper Canada experienced a second influx of immigrants. Anxious to build up the country, authorities made an offer of free land to residents of the United

States who would take the oath of allegiance to the Crown. The response was immediate and great numbers took advantage of the offer. These people came to Canada in times of peace and without the hatred and fears of those who came during and after the Revolution. Trade across the border was on a more friendly basis and finally resulted in a Treaty of Reciprocity between the two countries in the middle of the century. This treaty was a great boon to the farmers of Upper Canada who traded their produce for the manufactured goods from the eastern states free of duty both ways. The



Highway Map of Canada, circa 1850

great ports of entry into the United States were Oswego, Buffalo, and Sandusky. A ferry across the Niagara from Fort Erie to Black Rock carried enormous traffic and the roads in the Niagara area on the Canadian side carried their share of the load. The effect of this trade upon the highway system of Upper Canada was significant. Into Lake Ontario along its northerly shore flow scores of small rivers and creeks, a situation quite different from that obtaining along the northerly shore of Lake Erie into which flows only one sizeable stream, the Grand. As a result almost every creek mouth on the Ontario shore became a small port from which grain-laden schooners crossed the lake to Oswego and Port Ontario. From

these small ports roads were built back into the country to carry the horse-drawn traffic. The Toronto-Montreal road soon took second place as a commercial road to these "harbour" roads. On the northerly shore of Lake Erie, Port Maitland at the mouth of the Grand, as well as Port Dover, Port Rowan, and Port Burwell, carried on a similar trade, and the roads leading down to these places became busy highways.

During the height of this trade the Woodstock-Port Burwell road was built for the sole purpose of transporting tan bark destined for the tanneries of Sandusky in Ohio. It was typical of the roads of that time, gravelled in the high and dry places and constructed of corduroy where it crossed the swamps. The cost of its maintenance was enormous but its economic value made it worthwhile.

The abrogation of the Reciprocity Treaty after the Civil War abruptly ended the trade across the border; schooners rotted in the little harbors, warehouses and docks decayed, lights in the lighthouses were extinguished, and sandbars filled up and blocked the mouths of the creeks. The wagons and sleighs that had moved down to the harbor docks now turned eastward and westward along the main highways to the big towns, and grass grew over the old harbor roads. They had passed into history, for railroads had been built and steamboats had replaced sails. Such trade as could still be carried across the lakes would henceforth converge on the deep harbors at Hamilton, Toronto, Trenton, and Kingston. Although the harbor roads leading to the lake ports had gone, the roads inland still served a useful purpose in developing the country. Most of them are now paved highways of the provincial highway system.

During the last quarter of the century the highway as a factor in commerce gave place to the railway, and highway construction and maintenance ceased to be the concern of the central government and were left to the counties as a purely local matter.

However, one notable exception in Ontario (formerly Upper Canada) during this period was the building of the last military highway specifically designed as a defense measure against hostile action from the United States. The road known as the Monk Road was built from Ottawa, the Dominion capital, to Fort Penetanguishene on Georgian Bay. It was designed as an alternative route to the Trent Canal which connects Lake Ontario with Georgian Bay by way of the Kawartha Lakes. Laid out through exceedingly rough country, it is now only partly in use since long stretches have been abandoned and its bridges have fallen into decay.

While the original system of military highways was built by the government of Upper Canada, their maintenance thereafter was

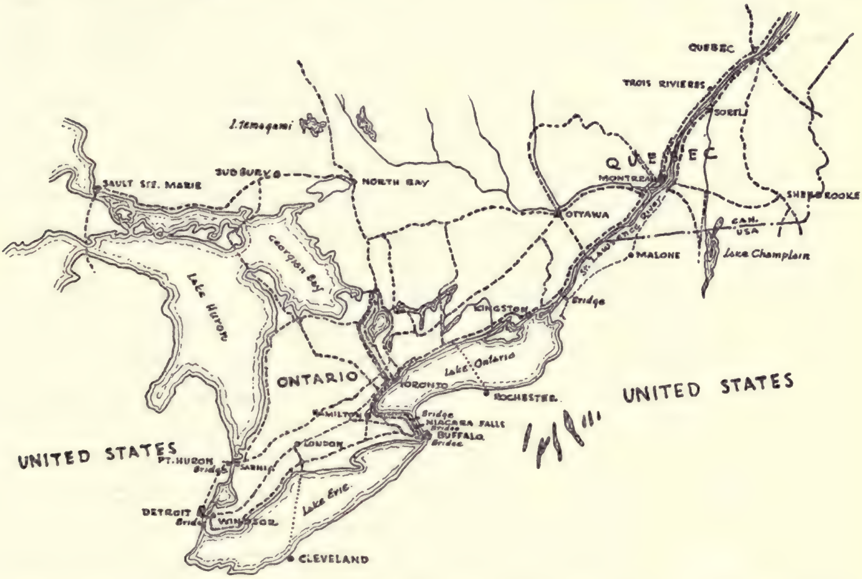
the responsibility of the county administrations. In 1901, however, the provincial government assumed the major portion of maintenance costs, and in 1919 a provincial department of highways was established for the purpose of developing a provincial highway system. This had been the logical result of the growing use of automobiles and consequent heavy increase in maintenance costs on the main suburban and interurban roads.

The motorcar literally put North American people on wheels, and on all Canadian highways cars bearing American license plates became a common sight. By 1913 the number of American cars entering Canada in the tourist season had so swelled the traffic on roads leading from the border that the cost and physical difficulty of keeping them in repair had become a critical problem. In Quebec this was true in the case of the road between Montreal and Lake Champlain, and in Ontario in the cases of the roads from Niagara and Detroit to Toronto. These two converged at Hamilton at the head of Lake Ontario and from there traffic to Toronto used the old military Niagara-Montreal road. To relieve the burden of traffic largely of American origin, a new paved road along the lake shore was built in 1913 from Hamilton to Toronto. This was the first paved highway in the country and its capacity was immediately taxed.

The end of the First World War found Canada quite unprepared for a greatly expanded use of its roads by American motorists. Bound for the vacation country in Ontario's Muskoka and Quebec's Laurentian mountain country, their automobiles choked the roads from the border and travel particularly at weekends became a nightmare.

The governments of Ontario and Quebec as well as those of other Canadian provinces met the situation by establishing provincial highway departments which at once took over the full responsibility of improving and maintaining the main traveled roads. Vast programs of reconstruction of designated roads were undertaken and in the decade following the end of the war the main highways of Ontario and Quebec had been regraded, straightened, and paved. In Quebec the first roads to receive attention were those from the American border to Montreal and from Montreal to Quebec City. In Ontario first priority was given to the Niagara-Montreal road, the Governor's Road from the head of Lake Ontario to the Detroit River and the old Portage Road (Yonge Street) from Toronto to Lake Simcoe. In something over a century since they were first built these old military roads which comprised the first highway system in Upper Canada now formed the first units and the backbone of the

provincial system of highways. In both cases the ruling influence was the American border, first to enable it to be defended and lastly to provide a safe and pleasant route from it into Canada for the people who once were unwelcome. The program of highway-building has been steadily carried on over the intervening years, greatly influenced if not actually dictated by the travel habits of American tourists on vacation. As the roads were driven deeper and deeper into the northern wilderness, the American motorists have followed in ever-increasing numbers. Like a river system of tributaries but



Highway Map of Central Canada, 1947, Showing Principal Border Crossings and Highways which Connect with Them

with no main channel the highway system soon became overloaded on the roads immediately across the border. In order to correct this weakness in the system the Ontario Highway Department in 1936 projected a system of super-highways as trunk routes to receive the traffic at its source.

Once again the old military routes approximate the routes of the new highways. From Fort Erie on the Niagara River opposite Buffalo the Queen Elizabeth Way follows the river to Niagara Falls, then sweeps along the southerly shore of Lake Ontario, rounds the head of the lake and runs eastward to the boundary of Ontario and Quebec. It is a dual type of four-lane road of the limited-access sort with grades separated at intersections and il-

luminated at night. The section from Fort Erie to Oshawa, thirty miles east of Toronto, is now completed and in use. As it runs along the shore of the Lake from Niagara to Hamilton it follows closely the route taken by Brant and his Mohawks when they made their first journey to their new home on the Grand River.

On the same pattern as the Queen Elizabeth Way is the new North Road from Toronto to Lake Simcoe and the Muskoka Lake country east of Georgian Bay. It is designed to carry the vast northbound traffic bound for the vacation resorts of Muskoka and Northern Ontario. In Quebec the same necessity of providing good roads from the border has resulted in a redesign of the provincial highway system with great highways running northward into the Laurentian Mountains, such as the road from Montreal to Ste. Agathe.

Throughout the whole of eastern Canada the demands of the visiting American motorists are determining the routes and capacities of Canadian highways just as the fear of a hostile invasion from the same direction dictated the routes and the construction of the country's first roads.

The Monk Road of a century ago was, as has been stated, the last military road built in Canada for the purpose of defense against the United States, and few there were then who could have foreseen a military highway project undertaken in Canada which would render insignificant all previous defense measures of its kind. For over fifty years the peoples of Canada and the United States have been coming to know each other as friends. The bitterness engendered by the Revolution and the War of 1812 has been forgotten and they have fought side by side in two great wars in defense of the same ideals. An indication of the friendly cooperation between them was the building of the Alaska Highway. Faced with a tragic loss of sea power at Pearl Harbor and the consequent exposure of Alaska to attack by the Japanese, the United States requested of the Canadian government the right to construct an overland route to Alaska through Canadian territory.

This request was promptly granted and as a joint construction project the highway was built from the Peace River to Fairbanks and White Horse, traversing a thousand miles of mountain and swamp and constituting an enduring monument to American and Canadian friendship.

15 THE HIGHWAY AND THE MEXICAN BORDER

BY CARLOS CONTRERAS

TENOCHTITLÁN, the ancient capital of the Aztec Empire, was founded in 1325; and when the Spaniards arrived in Mexico in 1519, they found a system of pathways and canals that the natives used as means of communication and transportation. There had been established, between the capital and the Gulf of Mexico, a regular service of delivery which bore the name of "Incicatelanti," the messengers that go fast.

During the first part of the colonial period some short roads were opened, but no effective system of roadbuilding was developed and the country had as means of transportation the Indian, the recently-introduced mule and burro, and the two-wheeled ox-cart.

The Spanish indifference to adequate highways, inherited from the Moor, was brought to the New World; but as the colonies grew and both internal and foreign commerce developed, demand arose for better roads and means of transportation. In the eighteenth century Mexico initiated a system of highways with Mexico City as the logical center because of its geographical situation. This gave birth to four important highways: (1) to Vera Cruz, by way of Puebla and Jalapa; (2) to Acapulco, by Chilpancingo; (3) to Guatemala, by Oaxaca; and (4) to Santa Fé, New Mexico, by Durango. Another significant road was the continuation of the highway from Vera Cruz to Mexico City to Guanajuato, Guadalajara, and the port of San Blas on the Pacific.

During the colonial period the highways were under the jurisdiction of organizations of merchants called "Tribunales de Comercio," and the funds to repair them were obtained from a special toll tax called *averia*—damage—paid by those who used the roads.

During the hundred years following the confirmation of Mexican Independence, only slight progress was made. Throughout most of the nineteenth century the principal means of travel was the stagecoach. The first line was started in 1830, between Vera Cruz and Mexico City by way of Jalapa, by three New Englanders; they used Concord stagecoaches driven by American citizens. In 1865 the government centered its attention on the building of railroads and two years later the toll on highways was abolished. Thus, at the turn of the new century, highway transportation in Mexico, with the exception of a few stagecoach routes, remained in prac-

tically the same condition as existed much earlier. Mules and oxcarts still struggled over primitive paths. These one hundred years of negligence and indifference toward the construction of highways—a period that included fifteen revolutions and much unrest—bring us to the creation, by presidential decree, of the First National Highway Commission of Mexico, in 1925. This body found that the only existing improved roads, in that year, were the roads from

Modern Road Map of Mexico

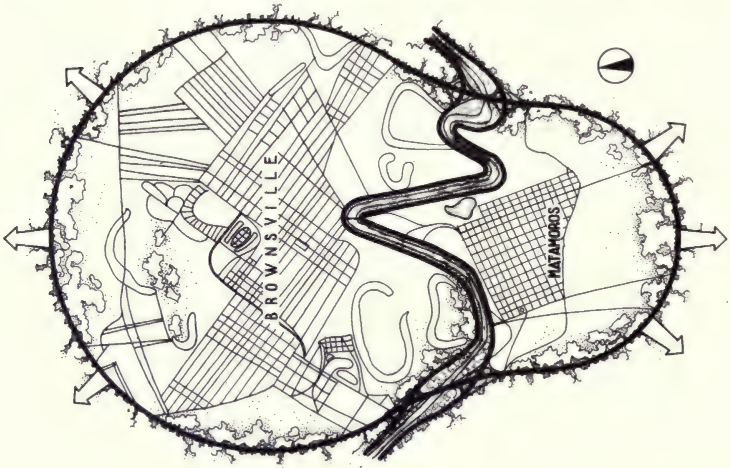
Mexico City to Toluca, to Cuernavaca, and certain sections between Cuernavaca and Acapulco. And this condition existed in a country with an area of 767,000 square miles, and with a population of 16,000,000.

Three members representing the President of Mexico and the Secretaries of the Treasury and of Communications and Public Works constituted the First National Highway Commission. The Federal government decreed on April 6, 1925, a special tax on gasoline of 2½ cents per gallon, later increased to 5 cents, for building highways in Mexico. This tax yielded from 1925 to 1930 about 45 million pesos and in the next fifteen years 100 million pesos more—or, approximately $30,000,000 in twenty years.

CIA. MEXICANA AEROFOTO, S.A.

AIR VIEW OF CIUDAD JUAREZ AND EL PASO

The close proximity of these two is typical of that of other "twin cities" along the Mexican border, a factor that demands cooperation in highway planning between the two countries.



CIA. MEXICANA AEROFOTO, S.A.

PLANNING PROJECT FOR TWO BORDER CITIES

Aerial photograph shows the city of Matamoros, which is separated from Brownsville by the sharp curves of the Rio Grande. The sketch (by the author) shows how highway facilities might be developed by construction of expressways paralleling the river and of parkways encircling the urban areas.

Among the first roads constructed in Mexico, under the direction of the Highway Commission, were those between Mexico City and Puebla, 80 miles, and between Laredo and Mexico City, 800 miles. In addition the following roads have been built: Matamoros-Monterrey-Mazatlan, 750 miles; Mexico City-Morelia-Guadalajara, 400 miles; Mexico City-Cuernavaca-Acapulco, 285 miles; and Puebla-Vera Cruz, 200 miles. Altogether a total of 2,595 miles of main highways was constructed under this program.

For the period 1930-1934 the budget for highway construction was 16 million dollars; while that for 1946 was about 20 million dollars and for 1947 it was 23 million dollars. By the end of 1940 Mexico had about 80,000 automobiles, and five years later saw a total of about 5,000 miles of highways laid out.

PROPOSED DEVELOPMENT

The border between the United States and Mexico, from Matamoros and Brownsville near the Gulf of Mexico to Tijuana and San Diego on the Pacific, covers a distance of about 1,810 miles. The Río Grande or Río Bravo serves as a natural boundary from the Gulf of Mexico to El Paso, and from there to the Pacific—with the exception of a short distance where the boundary is the Colorado River—the dividing line between the two countries is an artificial one.

The characteristics of the country along the border, on both sides, vary from flat lands to high mountains and ridges which give it high scenic value. The altitude varies from sea-level to 6,600 feet at the continental divide, while the geologic formations also exhibit marked differences in type as one travels from east to west.

The characteristics of the topography of the valley of the Río Grande clearly established that that river should not be *a dividing line* between the two countries but on the contrary should serve the friendly purpose of uniting them more closely. If this firm bond can be established, it is evident that political and military problems are not only simplified but should be eliminated through a clearly enunciated policy of mutual respect on equal footing in regard to internal matters of the two countries, and also through complete cooperation and collaboration in Pan-American and international relations.

In 1925, in New York, at the International Congress for Housing and Town Planning, the writer presented a suggestion for a program of highway construction in Mexico; and in 1941, in Philadelphia, a proposal for the construction of an "International Park" along the banks of the Río Grande.

Beginning in 1938 the National Chamber of Commerce of Nuevo Laredo, in Mexico, became active in promoting the construction of a highway along the Río Grande to link the principal border towns. Its general survey and proposals received wide attention: "The towns situated on the Mexican Border with the United States are passing through a precarious situation, due to many causes, but principally because of the lack of self-supporting means for they have always been, and continue being, tributary to the American cities located on the left bank of the Río Bravo, and to the important cities in the interior of Mexico.

"The American cities located in the same geographical situation as ours, nevertheless, do not have the same economic conditions as those on the Mexican side due to the fact that they all have their own means of livelihood: agriculture, and cattle-raising which provide them with economic independence and make them self-sufficient and intercommunicated by means of highways which link and bind them together.

"This is, in our opinion, undoubtedly, one of the principal advantages which these towns enjoy and which ours lack, for ours live isolated and unable to develop activities of any kind that might bring about an economic improvement to this region.

"The Board believes that not only agriculture and cattle-raising and commerce would be benefited in this strip of our territory with such rapid intercommunication but that this would favor, also, all official activities to control with greater facility, with smaller personnel and equipment, and with more satisfactory results, the cases of smuggling along the border as well as all military and customs vigilance and inspection along the river banks.

"We believe that in a national enterprise of this nature the Department of the Treasury, in relation to the improvement of customs service and vigilance, and the Department of Defence as to military service and defence, would be interested to such an extent as to give it their wholehearted support. We therefore propose:

"1. That the Department of Communications and Public Works, with the support of the Departments of National Economy, of the Treasury, and of Defence, consider in its budget for the year 1939, and with the cooperation of the governments of the States of Chihuahua, Coahuila, Nuevo León and Tamaulipas, the construction of a Border Highway which will cross and link the towns situated on the banks of the Río Bravo from Ciudad Juarez–El Paso to Matamoros-Brownsville;

"2. That the Federal government request the governments of the states crossed by this highway to make use of the gasoline tax

and to apportion, proportionately, fifty per cent of the cost of this road;

"3. To fix a maximum term of five years to complete this highway and to ask the Federal Government to determine adequate means of conservation."

In 1941, the Chamber of Commerce of Nuevo Laredo again requested the Federal and state governments to consider the urgent need of the northern states for a means of communication from east to west. It pointed out that the states of Sonora and Sinaloa in western Mexico are practically isolated from those of Chihuahua, Coahuila, Nuevo León, and Tamaulipas in the northeast; for notwithstanding the fact that the distance between them, in a straight line, is not excessive, one has to use, for transportation and communication, the Southern Pacific Railway in a roundabout way. The Chambers of Commerce of Matamoros, Camargo, Reynosa, Guerrero, Nuevo Laredo, Piedras Negras, Villa Acuña, Ciudad Juarez, Nogales, Agua Prieta, Tijuana, and Mexicali all gave their support to this plan.

The Chamber of Commerce of Nuevo Laredo, finally, asked the Federal government to promote the construction of the National Border Highway, with the cooperation of the local highway commissions in each state. With that end in view it asked the Governor of the State of Tamaulipas to approve the following suggestions: that the Local Highway Commission of the State of Tamaulipas include in its program for the period 1945-1950 the construction of parts of the Border Highway—Camargo-Mier, Mier-Guerrero, and Guerrero-Nuevo Laredo, to connect the city of Matamoros with Nuevo Laredo.

Largely through the influence of the various Chambers of Commerce, interest in the building of a Border Highway had practical results. The proposals constituted a well-defined program which was generally accepted by the Governors of the border states, and by the Federal government through the Ministry of Communications and Public Works. Both Federal and state building programs are currently being promoted.

In June 1949 the status of the Border Highway, as reported to the writer from the Ministry of Communications and Public Works, was as follows:

1. Between Tijuana and Mexicali a dirt road exists along the border (210 kms.)

2. From Mexicali to Sonoita work is progressing to permit travel on a dirt road (350 kms.)

3. From Sonoita to Nogales, nothing (275 kms.)

4. From Nogales to Agua Prieta, nothing (175 kms.)

5. From Agua Prieta to Ciudad Juarez, nothing (475 kms.)

6. From Ciudad Juarez to Vado de Ceballos, paved road (140 kms.)

7. From Vado de Ceballos to Nuevo Laredo, a project has been approved by the Ministry of Communications and Public Works. A dirt road runs between San Carlos and Piedras Negras (50 kms.)

8. From Nuevo Laredo to Reynosa, a project has been approved (320 kms.)

9. From Reynosa to Matamoros, paved road (100 kms.).

In order to promote higher production in fertile lands, the Mexican government has been attaching great importance to the development of agriculture in the lower Río Grande Zone; and it has ordered the Department of Communications and Public Works to build the necessary works of protection and defense against the constant threats and danger which have caused a constant and serious loss of crops and brought misery upon a large population. These improved and safe areas—properly linked with the Border Highway—will bring about a more logical distribution and balance of population which will in the future prove highly beneficial to Mexico.

In these vast areas the government will thus develop a policy to improve living conditions through greater production and economic well-being by means of a coordinated program of road-construction including, of course, the National Border Highway. In addition, the construction of public works will promote, at the same time, a program of irrigation and reclamation. This might involve the use of water from the overflows, either by side-channels or through the construction of a basin which might operate as a regulator of the currents and as a reservoir for irrigation purposes.

In addition the Mexican government is giving the necessary attention to a program for the proper redistribution of population, repatriation, and colonization through immigration; to the building of schools and hospitals to better the standards of education and health in these areas, and by improving the sanitary conditions to eliminate, as far as possible, malaria and tuberculosis; and, finally, to widen and improve credit facilities through adequate banking agencies and institutions.

It is the writer's belief that the strips of land on both sides of the border between the two countries should be made as "open" as possible for the use of the citizens of the United States and Mexico, who, in time, should be able to travel to and fro, unhindered and free from alien and immigration restrictions; the utmost cour-

tesy should be shown to residents of both countries by all officials in this "International Border Zone of the Río Grande."

The relation of highways to cultural and economic interchange with neighboring countries is nowhere so evident and clear as it is in this case. The International Border Highways on both sides of the Río Grande and the long western section of the boundary between the United States and Mexico would provide the means of a better knowledge of Mexican customs, traditions, history, ways and means of living, arts, music, folklore, dances, crafts, clothes, games, food, and also our common shortcomings. This knowledge, made easy by practical and efficient means of communication and transportation, will promote a better understanding and will foster a great improvement in the human, cultural, and economic relations between our two peoples.

Along the border on the American side, it should be noted, a transcontinental highway already exists, being composed of sections of U. S. 87, 90, and 80, and leading from Brownsville to San Diego.

The topography of the border region clearly points to three types of development in the planning of the National Border Highway:

1. In the areas where the altitude varies from sea-level to 650 feet, which is characteristic for some four hundred miles along the lower Río Grande and at the extreme western border;

2. In the flat urban areas of the several "Twin Cities": Matamoros-Brownsville, Nuevo Laredo-Laredo, Piedras Negras-Eagle Pass, Ciudad Juarez-El Paso, Nogales-Nogales, Mexicali-Calexico, and Tijuana-San Diego;

3. In areas between 650 and 2,000 feet in altitude which usually have definite scenic characteristics. The areas above 2,000 feet should be used for reforestation and maintained as Forest Reserve Zones.

The development of these types should constitute a whole—a unit—an "International Park and Parkway System" from the Gulf of Mexico to the Pacific, serving to bind our two countries together permanently with green and peaceful pastures, parks, and playgrounds.

These parallel "freeways"—from coast to coast—should have characteristics of great elasticity and variety in their construction. They should have transit lanes to provide for different types of traffic flow, either coupled or parallel at varying distances as means of defense and safety and for reasons of topography and convenience. Each rapid-transit vehicular lane should have a minimum width of

ten feet, and there should be ample facilities along the secondary slow-transit lanes on each side, including generous parking space.

The original right of way of the International Highways should be of a generous width. May we boldly say 300 feet? The *circulating* width should be increased *ad libitum,* and, of course, there should be well-planned approaches to the entrance gates and plazas of the "Twin Cities" and the international bridges which link the highways across the Río Grande.

The International Highways, on both sides, in the areas varying in altitude from 650 to 2,000 feet, should be narrower with two rapid-transit lanes and one slow-transit lane on each side. Wherever possible, planting strips, side parkings, and connections with all scenic regions should be established.

Easy access from the "freeways" must be furnished to the airports, to the cities that are by-passed, as well as to recreation and tourist centers, camping sites, and Forest Reserve Zones. Adequate gasoline, service, and police stations will, of course, be provided. The problem of water supply and sewage disposal must be considered as well as fire protection in the forest zones. Boundary markers should be designed and built at all bridge entrances and important points on both sides.

A police body might well be created, international and bilingual in character, speaking English and Spanish, made up of citizens from the two countries with the same uniform to serve as a distinguishing feature of this agency. In this area the two currencies would be accepted.

Great importance must necessarily be given to the principal highways which, leading from Canada and the United States, will cross the Border Highways near the focal points of the "Twin Cities." These highways will supply large volumes of feeder traffic. The writer believes that ultimately there will be four major highways, including the present Pan American Highway, connecting the border with Mexico City over the following routes: (1) Matamoros-Ciudad Victoria-Mexico City; (2) Nuevo Laredo-Monterrey-Ciudad Victoria-Mexico City; (3) Ciudad Juarez-Chihuahua-Mexico City; and (4) Nogales-Guaymas-Guadalajara-Mexico City.

The suggestions that the writer has made here will necessarily, of course, depend upon joint action by the governments of the United States and Mexico. The growth of population in the American Southwest, the attention currently being given by Mexico to the Río Grande region, and the increase of travel between the two countries will naturally throw greater emphasis upon the border regions over the coming years. Much may be accomplished by a

long term technical and financial program. The writer is emboldened to present this recommendation:

Resolved, that the governments of the United States and Mexico establish and create the "International Mexican-American Border Highway Authority"; that this authority shall be legally constituted with four members and a technical director; that each government shall appoint two members, one in each case being a planner; that the presidents of the United States and Mexico shall appoint the technical director; that the costs of undertaking in its aspects of planning, design, programs, surveys, administrative and technical personnel, equipment and construction phases shall be borne by the governments of the United States and Mexico; that the financial part of the program must provide the ways and means for the partial, if not whole, recovery of the investment; that the authority thus created shall have full powers to carry out to completion this undertaking for the benefit and welfare, as well as for the improvement of the cultural and economic relations of the peoples of the United States and Mexico.

16 THE PAN AMERICAN HIGHWAY

BY J. L. HARRISON

THE Pan American Highway usually is described as a system of presently existing and projected trunk-line highways which will connect this country with the countries of Central and South America. This, however, is somewhat less than a realistic description of its scope and of its objectives. True, these trunk lines are an important part of it but, in reality, the Pan American Highway is an idea—a conception—as yet not fully developed and only in part expressed in physical accomplishment.

This conception envisions a time when widely flung facilities for overland movement will have been constructed. Interconnections among all the Latin American capitals are envisioned as a first major step. Ultimately national highway grids will make it possible to travel comfortably by land from any point of importance in either of the major American continental areas to any other point of importance in that continental area or in the other. This is not a fully developed plan. It has not yet reached that stage. On the other hand, it is more than an idea, for much has been done to develop it, and to stimulate interest in it. It is a hope which is becoming in many respects an objective and in some a reality.

The Pan American Highway as an idea was first presented at the 5th Conference of American States at Santiago, Chile, in 1923. There the following resolution was adopted: "To recommend to the States belonging to the Pan American Union, especially when the necessary railroad communications are lacking, that they improve as rapidly as possible the transportation facilities between their most important cities by means of automobiles and between such cities and the principal ports permanently open to international traffic, and between the principal cities and the capitals of neighboring states.

"That an Automobile Road Conference be held at the time and place which the Governing Board of the Pan American Union may determine, which shall study the most adequate means for carrying out an efficient program for the construction of this class of roads in the various countries of America, and between such countries."

Since that date the Pan American Highway has been the subject of discussion at a number of international conferences, more particularly at the various Pan American Road Congresses which have

been held since the original resolution was adopted. While these discussions have covered, among other things, such matters as the selection of routes, standards of design, types of construction, etc., these matters, in practice, remain within the jurisdiction of each country. That is, each country selects the roads which, within its borders, will be recognized as its part of the Pan American Highway trunk-line system. It arranges with neighboring nations for common points of junction at national boundaries. It handles location, survey, design, construction, and maintenance within its boundaries. Except in Central America, where assistance in the construction of the highway has been given by the United States, both the cost of trunk-line construction and of lateral roads are financed by taxation in one form or another. In short, within each country the development of the Pan American Highway trunk lines and the development of the local grids are national problems and are treated as such.

Obviously, the broad objective which underlies the Pan American Highway is to serve a purpose of more importance than to help fulfill the ambition many Americans have to travel in regions not now readily accessible by land routes. It would hardly be realistic to assert that the satisfaction of this desire is of sufficient importance to warrant the negotiation of international agreements and special treaties, to say nothing of all the other efforts which are being made to further the Pan American Highway idea. On the other hand, it must be admitted that the desire to travel is widespread and that many Americans look forward to a time when it will be possible to motor long distances in other countries as easily as in our own. The same urge is found among citizens of the Latin American countries. Indeed, if it were not for this common desire an international system of highways could have relatively little importance, for if a thing is to be useful it must be used. And yet the reasons which encourage its use may not be those which generate its development. This is eminently the case in this instance, where promotion of the Pan American Highway is derived from the desire to improve Western Hemisphere solidarity.

It is not too much to expect that as facilities for international travel are developed, they will be used and the citizens of the various countries in this hemisphere will become better acquainted with each other. Acquaintance first breaks down prejudices and then develops understanding. Other nations have points of view which differ from our own; different conditions, social and physical, to meet; different problems to solve. As these and the other things which make a nation what it is are better understood, a friendly

understanding of its nationals replaces the attitude of critical suspicion which otherwise tends to keep nations apart. One has only to look north at Canada and south at Mexico to realize the difference which exists in our national point of view toward a neighbor with whom we have had full freedom of contact and with one where this freedom has been and, to some extent, remains restricted. True, the friendly understanding between Canadians and Americans has been made easier because of our common cultural background. However, it could hardly have developed had it not been fostered by the complete freedom of movement accorded the nationals of both countries into and throughout the territory of the other.

The real purpose that underlies the Pan American Highway is, then, the development of a facility which will assist in generating throughout the Western Hemisphere the same friendly relations between the nations in it that today exists between Canada and the United States. This is a magnificent objective. Its attainment is of large importance to every country in this hemisphere. That this is recognized both here and abroad is evidenced by the great interest that has been taken in it and the active efforts which have been and continue to be made to develop this system of highways.

While the ultimate objective is an interconnecting grid of highways reaching into all parts of the continental land areas of this hemisphere, it has been the practice in this country to describe the Pan American Highway as a system of trunk-line highways extending from Laredo, Texas, to points of importance in South America. In the United States no single route is designated as an extension of the Highway. The highway grid here is so well developed that no useful purpose would be served by showing a single approach to the Mexican border. For much the same reason the connections with the trunk lines in such countries as Peru, Chile, and the Argentine ordinarily are omitted. But this should not be construed as indicating a lack of interest in highway development abroad or any lack of active effort to expand existing facilities. There, as here, within the means at their disposal progress is being made in the development of the more local highways as well as the trunk lines which are usually shown on maps as the Pan American Highway.

As a matter of fact, the importance of developing the Pan American trunk line is widely considered so great that in several countries a considerable part of the available highway funds are and for some time have been spent on it. Mexico is a good example. There, the need for the development of the locally important parts of the national highway grid is urgent and much money is being spent on

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these highways. But, despite this and the fact that a further extension of the trunk line of the Pan American Highway in Mexico will have less local significance than attaches to many other roads awaiting development, Mexico continues to consider this trunk line as of major importance, and large sums are spent on it annually in an effort to open it to the Guatemala border as soon as possible. In other words, as a matter of national policy Mexico wishes to be better known and better understood and, with other countries in this hemisphere, feels confident that the way to accomplish this result is to make it easier for people from abroad to reach Mexico and to travel there.

While much work has been done on the trunk lines which ordinarily are shown on maps as the Pan American Highway and long stretches are in use, these trunk lines still fall short of providing first class facilities for international travel. There are still, for instance, several sections of some length where not even a trail exists. Perhaps the most conspicuous of these is the section of this highway which lies between the Panama Canal and the point at which connection ultimately will be made with the road system of the Republic of Colombia. The length of this section probably is in excess of 300 miles. However, no survey of it has, as yet, been attempted so about all that is presently known is that it lies in tropical country, much of which is rough, and that its construction will involve crossing the Atrato River, a large, sluggish, tropical stream to which approach is rendered difficult by the wide swamps on both sides.

In several other places there are sections more than 100 miles in length which still are almost as impenetrable as the one just south of the Panama Canal. More is known of all of these. Surveys have been run through most, and in some cases, though not in all, they can be crossed by automobile during dry weather even though nothing in the way of an improved road exists.

The fact that there still are sections of the Pan American Highway over which it is not possible to travel has been mentioned because many have been led to assume that through travel to South America is possible. Actually this is not the case and even though progress in the development of the trunk lines is being made, it will be several years before through travel can be undertaken with confidence.

It should also be observed that the development of the Pan American Highway is proceeding along the same general lines which were followed in highway development in this country. In developing our system of highways we have not always built wide

highways or high-type highways. Many, as initially constructed, were narrow and of low type. Many of those initially built to low standards were used for years before they developed enough traffic to require reconstruction or before funds could be made available for this purpose. This same situation exists to the south of us. As a result, when opened to through traffic, trunk lines will not universally be in the condition we associate with that term. Eventually that will come but, as has been the case here, improvement will be gradual and will extend over a considerable period. Once the trunk lines have been opened to traffic, many factors may be expected to influence the rate of their further development. Of these, the service they render to local needs seems likely to prove the most important for, in addition to the importance of facilitating international travel, every highway serves local needs. It follows, quite naturally, that when reasonable facilities for international travel over the Pan American trunk lines have been provided and as the public becomes actively conscious of the local values which are involved in the construction of such roads, they come more and more to be considered in the light of the service they render to local travel. This consciousness of the local values which result from the development of good roads expresses itself in an active demand for them, and this in turn usually results in active efforts to increase the amount of money available for their construction. The result is expansion in the road system as a whole. But, in this expansion, the importance of the service to be rendered to local needs—present and prospective—tends increasingly to become the factor which dictates where work will be done and the standards which will apply. The natural result is that after their initial construction trunk lines are further improved only as dictated by actual traffic over them, particularly traffic of local significance. This has been true in the United States and is becoming obvious in such countries as Mexico, Peru, and the Argentine. In all these countries, with no loss of interest in the development of trunk lines of international significance, there has arisen so widespread a demand for better roads to serve local needs that increasingly large sums are being spent to expand the internal road system. The construction of such roads is, of course, quite as much a part of the development of the broad conception of a Pan American Road System as the development of the trunk lines, for every new highway improves the accessibility of some area which the broad conception of the Pan American Highway assumes can sometime be reached. This is as it should be, but it is bound over the long term to retard the development of the trunk lines except as such development is en-

couraged by the service they also render to local needs. For this reason it is likely to be some years before all the trunk lines, even though open to traffic, will be improved in type, width, and other particulars to the standards we associate with that name.

It may also be mentioned that in many parts of South America the development of trunk lines and the expansion of the highway grid have been and will continue to be hindered by the difficulty and the expense of crossing the numerous large streams which are a characteristic of South America east of the Andes Mountains. Bridge-construction always is expensive and high costs will necessarily reduce the rate at which this work can be accomplished. In this country the cost of crossing major streams has frequently delayed the construction of much needed roads. This will be even more the case in eastern South America, for the rivers there are larger and more numerous and the amount of money available is less.

To those interested in travel abroad, it should be remarked that travel involves a good many other things than a car and a good road over which to drive. There must, for instance, be convenient points where gasoline, oil, and tires can be purchased and where repair work can be done, and safe hotels where the tourist can stop. A good many other things could be mentioned, but these are essential.

Abroad, the war interfered with the ordinary supply of gasoline, oil, tires and spare parts quite as much as in this country. As a result the procurement of these things has been difficult and in many instances the ordinary outlets have been closed. Outside the larger cities accommodations for tourists have also been adversely affected as would be expected under these circumstances. With peacetime conditions again prevailing, the customary service and supply facilities should again be available, but it may take some time to redevelop them. It should, however, be observed that the volume of highway traffic in Latin America never has been great enough to cause the development of hotels, tourist camps, gasoline stations, and repair shops on anything like the scale to which we in this country are accustomed. For this reason, it seems probable that those traveling in the countries to the south of us will find it necessary to give more thought to where it is wise to stop, and to how and where fuel, oil, etc. are to be obtained, than are given to these matters here.

As has been mentioned above, progress is being made in the development of the Pan American Highway, both on the trunk lines and on the national grids reached by them. In spite of the war, new sections of these trunk lines were constructed every year and ad-

ditional local roads were improved. Progress will now be accelerated, for the interest in this matter did not diminish during the war—rather, as the importance of Western Hemisphere solidarity became more widely appreciated, interest increased. It is confidently predicted that this interest will be maintained and that as a result of it and of the increasing local appreciation of the importance of good roads which is apparent in the countries to the south of us, good trunk lines to this Southland with well developed connecting national road systems, now in large part a hope, will become a reality within the not too distant future.

17 THE HIGHWAY FROM THE POINT OF VIEW OF THE ECONOMIST

BY SHOREY PETERSON

THE public road, with the new prominence that motor traffic has given it, presents issues in two areas which concern the economist, the fields of transportation and of government finance. Here, however, these two fields merge, and there appears a single many-sided problem of adjusting the customary methods of government to a new participation in the transportation industry and thus in that dominant area of activity which, under American institutions, falls to private enterprise.

Transportation by motor vehicle, including all trucks and buses and personally used automobiles, has gained a substantial place in the aggregate movement of traffic. The highway, an integral element in motor transportation, accounts for much of its effectiveness and an important part of its cost. Government bodies, in incurring this cost, lay claim to a billion or two dollars' worth annually of the nation's productive power, and assume a large economic responsibility in the use they make of it. The responsibility is that of a member of a joint undertaking. In motor as in rail transportation the road and the roadway together make up the physical side of the industry; but, whereas in the railway case the vehicle and the road are adapted to each other under a single management and administration of finances, in the case of motor transportation the two are separate and the state must promote effectiveness and economy in the industry mainly from the highway side, with only such loose supplementary control as can be exercised over the use of roads.

In this situation highway policy has several significant aspects. It must be decided how extensively, with what justifiable outlay, highways should be developed—in the aggregate, in particular areas, on specific routes. Policy must be formulated respecting the raising of funds, the proper placing of the financial burden. These matters, important in their own right, are bound up with the question of establishing a relation that is both economic and fair between motor transportation and the railways and other transport agencies. This chapter seeks to bring out the underlying nature of these somewhat overlapping issues, though without developing them fully or suggesting solutions in practical terms. A point worth noting is that only

in this area of underlying conceptions can the main policy conflicts be understood.

OPPOSED CONCEPTIONS OF THE HIGHWAY FUNCTION

The main source of difficulty in this field seems to lie in the dissimilar thinking we habitually apply to the work of government and the functioning of private business—what may be referred to conveniently as the public and private economies. While these ways of thinking are poles apart, the highway function cannot clearly and wholly be placed with either.

In the provision, under our established institutions, of that major portion of commodities and services which falls within the province of private business, two features dominate: (1) Goods are supplied, activities are expanded and contracted, on the basis of market demand and production cost. The demand sums up the interest of individuals in various products, the cost reflects the value of all resources, human and material, used in providing them. On this basis private decisions are reached regarding investment and production. There is thus no over-all collective judgment of what the public requires, of what a socially desirable assignment of productive resources would be. (2) Goods are paid for by the individuals who get them and have the use of them. This payment is based presumably on their cost—that is, on the value of the productive resources that go into them. Thus benefits and satisfactions are treated as private and individual. They are so treated, not because it is supposed that society collectively has no interest in them, but because it is the common unspoken assumption of a freely organized society that, if the private interest is served, the social interest will be also.

The essential role of government, on the other hand, lies in providing services for which this assumption is not valid—services for which there is little or no demand from the public as individuals but which are required by an organized community, services which can be performed only through the exercise of sovereign power, services whose nature is such that they cannot or should not be paid for by identifiable beneficiaries. Activities which are peculiarly governmental in these respects include the national defense, the maintenance of domestic order, the administration of justice, the provision of such popular education as a democracy requires, the care of the indigent and defective. From the nature of these services it follows (1) that the extent and character of their provision must be determined by an over-all collective judgment through government processes, and (2) that their cost must be spread by

government authority over the public collectively, with little or no recognition of the benefit to individuals.

But government does not limit itself to activities which are purely of this type, or, necessarily, even approximately of this type. For a variety of reasons it may, and often does, enter fields where the principles of the private economy can and do operate, wholly or in considerable degree. This happens when a government undertakes to supply water or gas or electricity or street-railway or bus service, when it markets forest or mineral products from the public domain, or even when it provides postal service.

The main economic issues concerning highways seem to have their root in a vacillating allegiance to the procedures of typically governmental activities, on the one hand, and, on the other, to the principles and standards which operate in the private economy.[1]

Originally, centuries ago, in the legal tradition which we in this country inherit, the highway was only a way, a route which travelers might follow without committing trespass. The idea of the "king's highway" began in such a right of passage. There was an exercise of government authority, but no development of a physical facility. As an instrument of social and political unity, the highway, in this sense, serves plainly a common public purpose. Thought of originally in this light, it may, in the course of time, undergo substantial improvement to serve commercial needs, and still not induce a reformulation of policy. Particularly if the specific beneficiaries are mainly members of the local political unit that looks after the roads, there may be considerable grading of ways and bridging of streams without upsetting the conception that roads should impose "a common burden because conferring a common benefit."

But history shows, if two notable instances establish a rule, that when highways come to play a major part in transportation, the view of them in strict collective terms breaks down both in theory and in practice. This was true in the 18th and early 19th centuries when the growing commerce of the Industrial Revolution turned

[1] Apparently this issue is in the minds of some commentators who have discussed whether highways should be treated as public utilities. This phraseology seems unfortunate, since the peculiarities of certain industries which cause them to be singled out and regulated as to rates and service are irrelevant to the issue here. The contrast is between the principles which operate throughout the whole private economy, on the one hand, and in the performance of such public functions as defense and policing, on the other. Whether highways should be handled according to one of these sets of principles or according to the opposite set is unrelated to such virtues and defects as public-utility regulation has disclosed.

to the public roads for accelerated and cheapened movement. The local governments were unable to take care of the traffic; and turnpike trusts of a quasi-private nature were set up to exploit the discoveries of Telford and McAdam on a business basis. Toll gates might seem offensive by customary usage, but there was effective logic in the idea that highway service, unlike other basic government activities, might be developed by ordinary investment standards and financed by specific beneficiaries, rather than the general public.

As railroad development pushed the highway back into its former local role, community responsibility was resumed and service to commerce was merged in the common service. But after a time the pendulum swung again with the 20th century development of motor traffic, and the forces that operated in turnpike days reappeared. The expenditures called for mounted rapidly. As long-distance traffic expanded, the close connection between community benefit and individual advantage dissolved, and the customary community responsibility for highways went with it. The new transportation called for standards of road improvement that could not be met under the prevailing conception of the highway function or through existing procedures. The competitive disturbance of other transport agencies, especially the railroads, pointed toward the subjection of highways to the same principles of control that operated in these related fields.

There was not, and has not been, any general and explicit adoption of a view of highways which would exclude them from that category of public functions in which we put the defense of the realm and the preservation of order. Effective changes in policy do not come through formulating new theories and imposing them. In so far as highways have been subjected in recent decades to the principles which operate mainly in the private economy, the change has come through the practical pressure of new problems. But the change has been possible because of the inherent nature of highway service which, in its primary modern role as part of the motor transport industry, serves specific users in a roughly measurable way and assumes a competitive place in the private economy. Changes so induced go no further than the impelling circumstances require; so that there has been no clear break with the older way of viewing roads or of providing them.

INVESTMENT IN ROAD IMPROVEMENT

This development is seen in the most fundamental problem of policy, that of determining the extent and character of highway

development, and a movement toward new standards is apparent. The standards which concern us here are not those which govern the technical side of roadbuilding. Technical progress is necessary whatever view is taken of the highway function. It contributes notably to economy without solving the economic question. Given the prevailing level of technical achievement, the economic problem is that of deciding what improvements to undertake and how elaborately to carry them out. The contribution of highway transportation to the nation's economic life, its demands upon the nation's productive power, its adjustment to other transport agencies, all depend in greater or less degree on how this problem is handled. The standards and procedures followed may chiefly resemble those recognized in the business world or in the more general operations of government.

If the latter course is followed there is no solution that will exclude the widest and most irreconcilable differences of opinion regarding highway outlays. Control of road improvement through judging its relation to the general welfare is as debatable, as devoid of dependable benchmarks, as deciding the proper peacetime expenditure for national defense or the right quantity and quality of popular education. Controlled in this way, highway projects are peculiarly subject to "pork barrel" political grabbing.

It is the essence of the difference between highways and battleships that highway expenditure can be guided on a more precise basis, that of the value of specific contributions to effective transportation. Highway policy has moved noticeably toward exploiting this difference. The inclination, the professional bent, of the engineers to whom road-planning is largely entrusted, has been to define and apply appropriate standards in transportation terms. It is in character for the engineer to be mainly concerned, not with broad matters of public interest, but with specific relations between road types and traffic conditions and with the quantities and kinds of traffic that are present or will probably exist for given routes or areas.

But more is involved if the investment criteria of the private economy are to operate. What is needed is a reasonably dependable valuation of the transportation service to be expected from any contemplated improvement, and a comparison of this value with the anticipated cost. This need has, in some degree, been recognized. Thus studies have been made of the savings in the expense of vehicle operation obtainable through various types and degrees of road improvement under various traffic conditions. Attempts have been made to evaluate the time saved through reducing the length of

routes and the congestion of traffic. On the other side, much attention has been given to an analysis of highway costs.

Any full application, however, of the value-cost calculus by which economic life is generally organized is painfully difficult in the highway field. With the toll principle of charging for given road services largely inapplicable under modern conditions, there is no automatic test of whether specific outlays are justified. What can be collected in state-wide levies on motorists provides no guide, since investment decisions must be rendered for specific projects. Since, moreover, the state is in a monopoly position in imposing these levies, the amount it can collect from road users gives no clue to the amount that it is economic to spend on roads. No automatic determinant, but only a calculated comparison of gains and costs, can serve.

On the benefit side, some of the main factors are decidedly elusive. Estimates of savings in vehicle-operating costs attributable to improvements may be fairly dependable, but estimates of time savings and of the value of the time saved are not. Also uncertain are evaluations of savings of lives, doctors' bills, and property damage. Least measurable, but perhaps as important as anything else in judging the demand for road improvements, is the increased comfort and pleasure of the motorist. It would be a serious error to subordinate the recreational use of highways to their industrial use in any economic calculation of this sort.

The costs, with which the value of road service is to be compared, are more easily determined; though, again, there are difficulties. The labor and materials for current maintenance may be set directly against current benefits; but, very largely, cost is determinable not by simply totalling expenditures but through economic and accounting analysis. Capital outlays must be spread, through a depreciation allowance, over the estimated years of useful life. The service of capital must be recognized as having a value and involving a cost, as it does in the private economy; but at what rate of return this cost should be set—whether, for instance, it should be governed by the rate at which the state, with its taxing power, can borrow—has been extensively debated. Similarly debated has been the question whether road improvements should be charged with a tax cost, corresponding to the taxes which presumably would have been paid if the same resources were used in private industry. But despite the particular difficulties, the general principle which should govern such a cost calculation is fairly simple, though it is often neglected. The cost of resources devoted to highways should be treated as being as great as the value of other products, other

commodities and services, which these resources would presumably yield if they were not used in providing road services. The problem is one of devising calculations to apply this principle.

Clearly there has been no full attempt to apply the value-cost calculus to highway development. Such difficulties as have just been sketched stand in the way, and traditional governmental procedures work against it. But there has been considerable effort in this direction, effort that seems well worth while. Despite the gaps and guesswork any calculation must entail, the focusing of attention on specific gains and costs, rather than on broad general benefits and the state of the public treasury, makes for a closer economy than is usual in public undertakings.

But, it may be asked, will not the development of highways simply on the basis of service to traffic mean the neglect of important public interests of the general type? Highways exert a broad educational influence; they improve social relationships; they promote political cohesion; they serve national defense. Are not these general benefits also to be taken into account?

It is fair to regard this question mainly as a carryover from the usual way of thinking about government functions, growing out of the peculiarly collective nature of some of them. Actually it is easy to endow much of private industry with great collective significance, if one is so inclined. There is no greater social interest than in having the population well fed and housed. The steel industry is vital to national defense. Railroads perform the specific social functions credited to highways. The point is that, in a society such as ours in which an individualistic economic organization is generally approved, it is usually deemed sufficient that an industry should develop in response to the demands of specific beneficiaries, and that the social benefits should be accepted as a sort of byproduct. If the steel industry, spurred by ordinary demand, expands sufficiently for defense purposes, further development because of the defense aspect would be wasteful. But if, as in the case of the American merchant marine, the ordinary demand is not believed to bring forth what some collective purpose requires, additional investment on the latter account is indicated.

Thus, if highways, when developed simply in response to traffic needs, serve adequately the several general interests mentioned above, no additional outlay because of these interests is warranted. But if further development is necessary, say to establish a consolidated-school district or to tie in outlying areas politically or defensively, an appropriate additional outlay should be made. Because of the frequency of loose analysis when common benefits can be

adduced, this distinction is worth stressing as an essential aspect of the procedures by which economy is ordinarily achieved in using resources.

Calculations to control road development in close accordance with transportation needs are most likely to be upset when highways figure prominently in public-works programs which are undertaken to combat unemployment. As government assumes a greater responsibility to maintain full production in the whole economy, highway expenditures are likely to be aimed increasingly at ends other than serving traffic. The highway problem is submerged in a larger issue of public policy.

Actually the basic principle of economy in using resources still applies in this case. The difference is that resources which are idle and are being wasted are, from a social point of view, free of cost. Their use means the giving up of no alternative product, so that what they yield is net gain. When labor hired in this way is paid good wages, the resulting highway or other project may not always seem worth its money cost, but it may still be economically desirable. Nevertheless, any extensive use of road improvement to expand employment must make investment calculations in transportation terms seem less worth while, and must certainly complicate other highway problems now to be mentioned.

FINANCING ROAD IMPROVEMENT

Developing highways is one problem; paying for them is another. The shifting popular view of the highway function is best indicated by the readiness with which the public, faced with the need for automobile roads, has accepted the principle that the user should provide the funds. Development of motor-fuel taxes and license fees as the major source of funds belongs in principle, if not in form, with the toll gate of the turnpike era. Judged by the narrow definition of a tax, that it is a compulsory levy imposed without reference to benefit derived, these levies are not taxes at all but payments for road service, constituting the closest *quid pro quo* that the nature of modern traffic permits.

Sometimes, especially for propaganda purposes, they are otherwise construed. When an occasional spokesman for the railroads has lamented that their truck and bus competitors are subsidized through being allowed to operate over free highways, he is ignoring the obvious nature of these special levies as payments for road use. So, also, is the spokesman for motor transportation when he claims that his industry is the most heavily taxed in the country. But in general the fuel and license levies are accepted for what they are,

and with approval. No fact could more clearly demonstrate the distinctive nature of highways among the basic government functions.

Nevertheless such use of the taxing machinery is a rather crude substitute for a system of specific charges for road use. In its application there are a number of areas of controversy, and some interesting issues are raised.

It is debated, for instance, whether these special levies should cover the entire cost of highways, or only part of the cost. One argument is that the public, conceived as the body of general taxpayers, supported road improvement before the automobile age because of the collective interests served, and that, since these collective interests continue, only the additional cost of motor roads should be charged to the traffic. The opposite view is supported by the logic of the processes of the private economy, stated above, which, in fact, supplies the theory on which the special levies rest. If the steel industry, or any other, is supported sufficiently by its customers so that it provides incidentally any service that the general public expects of it, the citizenry as taxpayers do not subsidize it because of this community service. The logic of subsidies is often misunderstood. It is not that fairness requires a public sharing of expense because of common benefits. It is rather that, in the absence of a public contribution, the public does not get the service it requires. By this logic, the main cost of highways would be borne by road users, but any road or right-of-way expense not required in the service of traffic would not be so financed.

There is also an extensively debated question as to the best way to measure the cost that traffic should bear. For the purpose of guiding investment, as seen above, a calculation of annual cost, including imputed investment items, provides a basis of comparison with the value of road services. Such a calculation may also be used to determine the sum that should be raised through special levies on traffic. On the other hand, these levies may be based on the actual money outlay for construction, maintenance, and administration, and interest on highway bonds. Since this actual outlay includes capital and current items, it may involve a higher or lower figure than the calculated annual cost, depending on the amount of new construction. As a means of avoiding the subsidizing or overcharging of present traffic, it is theoretically defective. But it is simple and popularly understandable, and it fits into the established procedures of government finance.

Another difficulty, or group of difficulties, grows out of the fact that the fuel and license levies are applied on a state-wide basis, without reference to which roads are traveled, rather than as

charges for using particular roads or classes of roads. Depending on type of improvement and volume of traffic, the cost of highway service on different roads varies considerably when calculated on a vehicle-mile basis. It is wrong in principle, and bad in practice if the differences are substantial, to expect all traffic to contribute uniformly to the support of local developments the cost of which is exceptionally high. Actually the classification of highways as state, county, township, and city may be the basis of different schemes of support, but the differences do not invariably foster a more equitable spreading of the cost. Unfairness is aggravated if persons, though paying fuel and license levies at the usual rates, use their cars mainly on local roads or city streets which they pay for, wholly or in large part, through general taxation, in the absence of substantial allocations from the special levies. This is another situation in which established procedures may conflict with the logic of administering highways strictly as transport facilities.

The funds collected by means of fuel levies, which reflect both the size of vehicles and the distances they run, and by means of license fees, which are supposedly adjusted to the highway demands of various vehicle types, can never correspond perfectly to the cost of the highway services used. These deviations from a strict standard of equitable charging are inescapable and need not be serious. But, on economic grounds, there is real basis for criticism when the scheme of charging is governed, not by the cost of road services, but by traditional legal theories or popular prejudices regarding rights to highway use and which uses have priority. When differential treatment rests on the assumption that the ordinary motorist is the one for whom the road is chiefly built and the commercial user is enjoying a special privilege, or that the farmer using his own truck is to be preferred over the trucker who carries for hire, economic ends must suffer somewhat. The traveler in the bus should receive as favorable treatment as the traveler in his own car, and the shipper via a motor-transport line should suffer no arbitrary exaction that is escaped by the shipper who supplies his own truck. The essential nature of transportation should not be confused with the manner in which it is organized and conducted.

RELATION BETWEEN TRANSPORT AGENCIES

To the economist much of the interest in highway policy springs from its bearing on the relation between motor and other means of transportation, particularly that by rail. The competitive relation between agencies, the division of the field among them, depends in part on the regulations to which they are subject as

administered by the various commissions. But mainly the determination of the place each will occupy depends on the verdict of the public through its patronage, in response to cost and service factors. Prominent among these factors are the extent and character of highway development and the charges imposed on road users, just discussed.

The interest of the public in effective and economical transportation calls for encouraging each agency to exploit its potentialities without special favor or burden. This result is promoted when highways are administered, as fully as is practicable, in terms of transportation service rather than general social effects. The more closely specific values and costs are recognized, both in developing roads and charging for their use, the better the result is likely to be. Theoretical perfection is not to be expected, but the desirable goal should not be obscured by the difficulties involved or by preoccupation with the older, more political view of highways.

Broadly viewed, then, the economic problem of highways is one of adjusting a traditional public function, inevitably subject to the peculiarities of government processes, to the standards of the private economy into which transportation should be made to fit.

18 THE INFLUENCE OF HIGHWAYS AND TRANSPORTATION ON THE STRUCTURE AND GROWTH OF CITIES AND URBAN LAND VALUES

BY HOMER HOYT

THE points of origin of many great cities, which fixed the spots that were occupied by the first commercial and financial districts of those urban clusters with their peaks of land values, were located by the intersection of routes on the main stream of international trade or at breaking points between water and land transportation. Babylon, Ctesiphon and Bagdad successively arose near the intersection of the main overland routes in Mesopotamia. New York grew as the chief port on the great current of goods flowing between northeastern United States and northwestern Europe, and Wall Street near its point of origin on lower Manhattan is still the paramount American financial center. Other great cities developed as political capitals and like Rome gave rise to a network of highways leading to all parts of their states.

To the forces of commerce, the 19th century added manufacturing as a cause of urban concentration. The factory system, first developed in England as a result of the inventions of textile machinery and the steam engine, was based principally on coal for power and iron for the bodies of engines, tools, and fabricated goods. As the industrial system spread to Germany, northwestern Europe, and the United States, all of which had huge coal and iron deposits within their continental boundaries, great industrial cities like Pittsburgh rose where iron met coal to create basic blast furnaces and steel mills.

The steam engine itself created new means of transportation, the ocean steamer, the river steamboat, and the railroad running on fixed tracks. The acceleration and cheapening of ocean traffic stimulated an enormous growth of port cities like New York, London, Rio de Janeiro, and Shanghai. The river steamboat in the United States in the early 19th century caused the rapid growth of river cities like Cincinnati, St. Louis, and New Orleans, and their levees along the river front were the chief business centers. Then the railroads, at first only a connecting link between rivers and canals, struck out boldly just before and after the Civil War into long overland routes, and the railroad station became the nucleus of the urban center in

the latter half of the nineteenth century. Sometimes, as in Chicago, the railroads terminated at the meeting points of the early land and water commerce, so that the early central business structure was reinforced rather than shifted, and in most cases railroads tended to follow the river valley or the edge of the lake because of the easy grade. In other cases, the railroads later located their stations in valleys at a considerable distance from the waterfronts, as in Kansas City. Inland cities which were exclusively rail centers grew rapidly. Atlanta, at the intersecting point between the best rail routes from New York and Chicago, became a great transportation hub. Denver expanded when the Moffet Tunnel opened a shorter route through the Rocky Mountains.

The railroads, of vital importance in generating the growth of entire cities, also had a marked influence on the internal structure of several large cities after the Civil War. Suburban railroad service, first inaugurated in Chicago in 1856 and also a prominent transportation element in New York, was responsible for the rise of residential towns, occupied by workers, which sprung up at intervals along the railroads radiating from the metropolitan center. As these communities gradually coalesced in solid bands, the settled area map of the New York and Chicago metropolitan area showed long finger-like appendages extending out, with large vacant areas lying in between. This was the result of the faster travel time on the suburban railroads than on other means of transportation. When one can reach New Haven, Connecticut, 73 miles from the Grand Central Station, in the same time it takes to reach by bus some places in New Jersey only 13 miles away, it is no wonder that bands of houses extend along the railroad from New York City into Connecticut, while there are great vacant tracts within a few miles across the Hudson River.

In contrast to the star-shaped urban areas produced by the railroads, there were concentric cities like Baltimore, where cobblestoned streets and slow internal transportation caused the nineteenth century city to assume a circular form in which most of the residents lived compactly in row houses.

The structure of American cities was also being shaped by purely internal means of transportation. At first movement by walking and horse-drawn vehicles on unpaved roads restricted the limits of city settlement to a narrow compass and forced families to live in tenements in New York or row houses in Philadelphia or Baltimore, or houses erected on both the front and the rear of lots as in Chicago. Plank roads in Chicago, as early as the 1850's, produced tentacles of urban growth extending out into the prairie. Then came the horse-

car in Chicago in 1859 which operated on fixed tracks at a speed of 4 to 6 miles an hour. This extended settlement in bands along the leading arteries on which these horse-drawn street cars operated. In the 1880's the cable car speeded up transportation in Chicago along trunk lines to 12 miles an hour, but the horse cars still operated as feeders. In 1878 in New York and in 1890 in Chicago, elevated lines were inaugurated, operated at first by steam and later by electricity. These lines stimulated apartment construction along their routes. Beginning in 1890, electric surface streetcars were introduced in American cities; and supplanting first the horse cars and then the cable cars, except in San Francisco where cable cars still operate on the steep hills, they became the chief form of internal urban transportation by 1910 when they were at their peak. In a few of the largest cities, beginning in Boston in 1898 and in New York in 1904, the expensive but rapid form of underground transit was introduced. New York City has the most comprehensive system of subways; and they have had a profound influence on its pattern of growth, causing great ridges of apartments to rise along subway lines with great apartment clusters around many subway express stops and also stimulating fan-shaped suburban growth in areas connected by bus with subway terminals. In the United States only New York, Boston, Philadelphia, and lately Chicago in its downtown areas have subways, and in Europe subways are confined to London, Paris, Berlin, and Moscow. Subways are required only in the largest and most concentrated urban masses.

All these forms of transportation, railroads, streetcars, cable cars, elevated lines, and subways, operating on fixed tracks, tended to develop tentacles of growth along their routes with high population densities in central areas, leaving vacant or less intensely developed sections a mile or so from their stations. Most of these transportation systems, unlike the concentric subway system of Paris, also tended to pour people into the downtown area and to promote an extreme concentration of shopping, entertainment facilities, and finance in that area. This concentration was facilitated by the evolution of the steel frame skyscraper, first developed in Chicago in 1884, which caused central office areas of most American cities to expand vertically rather than laterally after 1890. As a result of the transportation systems which funneled the population of American cities into limited downtown districts, where the great department stores, theaters, banks, and office buildings were crowded together within walking distance, land values in these central areas represented a large fraction of the total land values of American cities in the early 20th century.

In 1910, the value of land in the half square mile of the Chicago Loop was $600,000,000 or 40 per cent of the total value of all the land in the 211 square miles in the city limits. The land in Manhattan, which was the focus of suburban railway lines, subways, and buses, as well as ocean ships and transcontinental railroads, was assessed at over five billion dollars in 1930, or more than the value of all the farm land in twenty-three American states in 1925. The corner of State and Madison Streets in Chicago where the greatest crowds of shoppers congregate was leased in the 1920's on a basis of $50,000 a front foot or at the rate of $21,780,000 an acre; and one small parcel at 1 Wall Street in New York City sold for $1,000 a front foot or at the rate of nearly $44,000,000 an acre in that same fabulous era.

Such was the effect of constructing huge capital investments in fixed transportation systems like railroads, street cars, elevated lines, and subway systems, which collected people from the periphery and poured them through a funnel into concentrated downtown business districts.

Suddenly a new flexible transportation medium appeared which ushered in a revolutionary change in the pattern of new growth of American cities. This was the automobile. A toy, a luxury, a racing model at first, it finally became a mode of private transportation possessed by nearly every family. Stimulating a vast investment in new concrete highways, criss-crossing the nation, it removed the limited horizons of the horse-and-buggy age; families now got in their cars and sped from New York to California or to Florida.

The effect on the structure of cities was not registered immediately. By 1930, there were over 26,500,000 motor vehicles registered in the United States, and yet new residential developments still clung cautiously to areas served by street cars or suburban railroads. After 1935, however, it was suddenly realized that the new concrete highways, the use of septic tanks, power-driven pumps for water, the extension of electric light wires and gas mains, enabled home developers to utilize farm lands that extended far beyond the main settled areas of cities and in between the spokes of community developments along suburban railroads. Facilitated by Federal Housing Authority financing, whole new communities sprang up within the orbit of metropolitan centers but at points distant from fixed rails. The lure of cheaper land, more open space, entirely new home communities and easy financing terms beckoned families to the metropolitan fringe. In the decade from 1930 to 1940 the unincorporated urban territory was growing much faster than the incorporated central areas which were actually losing

population at their centers. Moreover a large proportion of the wealthier members of the community were going to the suburbs, leaving in the central cities families with lower income to support the ever-increasing tax burdens of the urban cores.

This outward flow of population had a profound repercussion on central business districts. The individual family automobile, requiring considerable space to park, produced congestion on downtown streets and slowed up traffic. This congestion, in turn, caused families who had moved beyond the orbit of mass transportation to seek retail outlets where ample parking facilities were provided. New satellite shopping centers with a full complement of branches of downtown department stores grew up in Oak Park and Evanston near Chicago, and in White Plains near New York. Meanwhile many factory owners, faced with the congestion of downtown streets, tended to move to outlying industrial districts where they were served by belt railroads and by trucks, where their workers could park their cars, and where they had room to spread out in more efficient one-story factories.

Thus the new automotive transportation tended to spread out the great metropolitan conglomerations over a wider area, because a mile or so further means little to a man in an automobile. Cities developed chiefly in the automobile age like Los Angeles or Miami assumed a very diffuse form, with some blocks or areas only partly developed with houses and streets and utilities spread wastefully over great areas of thinly settled urban territory. Nevertheless the automobile has not yet tended to break up large cities into small ones; it has only enabled families to take advantage of the laws of geometry to the effect that the area of land increases with the square of the radius from the center of the city and that as you double the radius, you do not merely double but quadruple the land area available for new homes. In the case of most cities, the automobile has opened up far more vacant land for urban settlement than can ever be utilized. Hence there is no justification for land speculation on the basis of a limited supply of land except in the case of sites near good mass transportation routes in some of our largest cities.

To the automotive power by land has now been added the automotive power by air. This has made Chicago a suburb of New York—or vice versa depending on the point of view—and with future airplanes going between these cities in two hours, a home near the New York airport is closer in time to Chicago than to some other parts of New York City in Staten Island. Nevertheless while the airplane will enormously extend the radius of weekend or vaca-

tion travel, it is not likely, at least until helicopters are perfected, to alter profoundly the daily movements of population from home to places of employment. The time taken to travel to the airport consumes time saved in air travel in distances below 100 miles and it is hard to conceive of hundreds of thousands of people descending on New York City daily in helicopters.

The highways through the air and the power exerted by airplanes, friendly and hostile, may nevertheless exert a great influence on the future structure of cities. Air commerce can fill gaps where there are no railroads at all, and facilitate the movement of light, expensive cargoes. The fear of air bombing may cause some dispersion in future cities and some decentralization in new industrial building which will promote further decentralization of the homes of the workers in those industries.

The location, shape, and size of our cities has thus been a function of the form of transportation system prevailing during its main period of growth. Cities erected in the horse-and-buggy days still retain street patterns and buildings designed to meet the needs of an earlier day, and the inertia of invested capital and the multiplicity of ownership prevents a complete recasting to meet changed requirements. Yet as the new forces impinge upon the old, the new growth of the city tends to orient itself to the latest transportation mode. The grafting of the new growth, based on a different transport system, upon the old often produces irregularities and paradoxes in the city structure which can be explained only by reference to the historical evolution of the means of transportation during the life history of the city. The outbound movement of goods produced within the urban area to the hinterland outside to pay for the food, raw materials, and fabricated materials which the city does not produce itself and the inbound shipment of necessities from the country districts to the city are essential to its continued existence. Hence a city can live only when there is a transportation network connecting it with a food-producing area. Similarly when cities grow to large size they cannot function without an internal network of transportation which moves the workers from their homes to the places of employment. The highway and transportation system connecting the city with its outside producing and trade area is thus its lifeline from which it draws its nourishment, and its local highways and mass transportation system are its internal circulating system, which distributes its sustaining life stream to all its members.

19 HIGHWAY FINANCES AND RELATED PROBLEMS

BY SIGVALD JOHANNESSON

SOURCES OF HIGHWAY REVENUES

In the earlier days of the United States the principal purpose of highways was to provide a means of free access for people to their individual holdings as well as to their outside world, which at that time rarely extended beyond the limits of their own community. The matter of obtaining the money necessary for highway purposes, therefore, was then almost entirely a local problem.

However, as the population increased, the local highway systems were enlarged, traffic became heavier, connections were made to the road systems of adjacent communities, and the range of travel reached beyond the local limits until the financing of some of the highways became a problem of concern to the state.

Still later, with the development of the automobile, there was a rapid multiplication of highway traffic, which not only extended beyond state borders but demanded heavier expenditures for improved pavements and other highway appurtenances. Some of the roads became of interstate importance. The Federal government recognized this condition as well as the general advantage to the country of encouraging the building and improvement of highways, and it became, therefore, a participant in the furnishing of funds for highway purposes.

Generally speaking, the financial interest of the state and Federal governments in the development of highways is of recent origin. Even as late as 1921 nearly three-fourths of the money used for highway purposes was collected from local sources, whereas twenty years later only about one-quarter was furnished locally. Of the remainder, the Federal government provided a little less than one-quarter and the state governments rather more than one-half.

LOCAL SOURCES

Even though vehicle traffic has increased enormously since the automobile made its appearance, by far the larger part of the now existing highway mileage still carries but little traffic. At the present time there is a total of approximately 3,000,000 miles of highways in the United States outside of towns and cities, and on more than 80 per cent of this mileage the average traffic amounts to only 22

vehicles per day. The traffic on many of these lightly traveled roads is probably not much greater than it would have been if the automobile had not been in existence, but the means of transportation would have been different. The journeys would have been made by horse-drawn vehicles, on horseback, by walking or other available means.

These lightly traveled roads are used almost entirely for local purposes and are paid for from local tax receipts. However, their original cost has generally been quite low, and probably more than two-thirds of their aggregate mileage is still either entirely unimproved or has received only minor improvements. On a mileage basis the cost of maintaining these roads is generally quite small.

In more densely populated areas many highways are supported by local funds although they carry a measure of foreign traffic in addition to serving their purely local purposes. The presence of this additional traffic may add materially to the cost of maintenance and place an undue burden on the local finances. At the present time the minor local government divisions tend to unload at least a part of this burden either on their county or their state government. This policy is natural, and probably the time is approaching when, in equity, the money value of these roads to the local people as well as their transportation value to outsiders should be estimated so that the road costs may be fairly apportioned. This, however, is a problem which will require a thorough study before it can be solved in an equitable and satisfactory manner.

STATE SOURCES

The principle of furnishing financial state aid to the local government divisions for highway purposes seems to have originated as early as 1891 in New Jersey, when the Legislature authorized financial aid to the counties for road construction.

Throughout the country, state aid in the beginning was generally furnished from general tax revenues, but as the need for funds rapidly increased, not only for the support of the local roads but also for the construction and maintenance of state highway systems, as they began to develop, it became necessary to create new sources of revenue; and the most important of these have been motor vehicle registration fees and taxes on gasoline used for operation of the vehicles.

During the ten-year period from 1934 to 1943 inclusive, the total average revenue from these and other minor sources has amounted to approximately one billion dollars a year, and in the last few years about two-thirds of the total state revenues applicable to highway

uses have been derived from motor fuel taxes and about one-third from registration fees. Other sources account for only a small fraction of the total.

Registration Fees. Registration of motor vehicles was started about 1895, in which year the records indicate that four passenger cars were registered. In comparison, the total number of motor vehicles registered in the United States in the year 1948 had risen to more than 40 millions.

While as a whole there appears to be no serious difference of opinion on the equity of the amount of the fees prescribed for passenger vehicles in the various states, there is in some of them a considerable divergence of view as to the proper basis for determining the fees for trucks and buses, which divergence is due principally to the conflicting interests of the various types of carriers. It presents an important financial traffic problem that is being diligently studied, but which as yet has not been entirely solved. The study must consider the economic and social importance of the conflicting interests and the extent of the areas within which the conflict may exist. It must consider also the relative costs of construction and maintenance of highways that may in equity be assigned as resulting from the operation of passenger cars and heavier transportation vehicles respectively.

Gasoline Taxes. State taxes on gasoline were initiated about 1919, in which year a tax of 1 cent per gallon of gasoline used for motor fuel was collected in three of the states. The public reaction to the gasoline taxes appears to have proved satisfactory, because within the next ten years they were not only introduced in all of the states but the average amount of tax per gallon was increased materially.

In 1932 the taxes on gasoline were further raised by the levying of a Federal tax which has ranged from 1 to 1.5 cents per gallon. Within the last few years (1941-1947 inclusive) the average total state and Federal taxes on gasoline throughout the United States have amounted to about 5½ cents per gallon.

A contributing cause to the general acceptance of the gasoline taxes probably has been that the cost per gallon of gasoline to the user on the average has decreased rather than increased in spite of the continually increasing taxes. In 1920, when only a few states imposed a tax, the average price to the user was more than 29 cents per gallon. By 1927 it had dropped to about 21 cents although the taxes had increased to nearly 3 cents per gallon. Since that time it has fluctuated somewhat, and in 1941 immediately before the beginning of the war the average cost was less than 20 cents per gallon, including all taxes.

At least in part, the reason for the decreasing cost of gasoline may be that the manufacturers foresaw the coming of the taxes and felt concerned over the possible effect thereof on the buying public. Consequently, they made efforts to improve their methods of manufacture of gasoline so that they could produce it more economically, and their efforts were apparently successful. It may be worth while keeping this in mind when seeking new sources of revenue.

Diversion. It is stated above that for some years the total of the state revenues applicable to highways has amounted to about one billion dollars a year. However, all of this money has not been assigned to highway purposes, but some has been diverted for other uses. For example, during the three-year period from 1940 to 1942 inclusive, a total of $615,000,000, or about 18 per cent of the entire revenue was so diverted.

The question of whether or not state revenues, obtained from sources directly related to the lawful operation of motor vehicles, should be used for purposes other than the betterment and maintenance of highways has been debated for many years and is a problem yet to be solved completely. Up to the present time 16 states, California, Colorado, Idaho, Iowa, Kansas, Maine, Michigan, Minnesota, Missouri, Nevada, New Hampshire, North Dakota, Oregon, South Dakota, Washington, and West Virginia, have met the problem by approving constitutional amendments debarring diversion, and in several others the necessary machinery has been set in operation for determining whether it should be so prohibited. The states which have passed constitutional amendments are not within a limited regional area, but are well distributed throughout the country except in its southerly parts.

Some people approve of diversion in principle. They do not believe that state revenues from motor vehicle fees and gasoline taxes must necessarily be used for highway purposes. They agree generally that these revenues might be invested to advantage in highway work, but they hold that the revenues must necessarily be used to cover those expenditures of immediate importance for which no other money is available, due to the continually increasing cost of state government.

However, in normal times, when the government of a state functions economically, it is usually a healthy sign that its costs are rising. It indicates that the people of the state are prospering, that their standard of living is rising, and that they are able and willing to accept the greater cost ensuing from that higher standard. On the other hand, sources of revenue may be antiquated and insufficient to meet the increasing costs. The problem of diversion, therefore, may

be only a symptom of a deeper problem, namely that of finding means for carrying out the increasing work imposed by a rising standard of living. When that problem is solved, the minor problem of diversion will lose its present importance.

FEDERAL SOURCES

The present system of providing Federal aid to the states for highway purposes was initiated by the Federal Aid Road Act of 1916. By it, the annual appropriations made available by Congress were apportioned to the several states in proportion to their area, population, and post-road mileage. The Federal Highway Act of 1921 established the primary Federal Aid Highway System and restricted Federal aid appropriations to it. However, by the Hayden-Cartwright Act of 1934, the Bureau of Public Roads was enabled to extend aid to roads outside of the Federal Aid System and to establish the Federal Aid Secondary System. Under the Emergency Relief Appropriation Act of 1935, authority was given to the President to expend funds for railroad grade eliminations on highways not included in the two Federal Aid Systems.

The Federal Aid Highway System within each state is intended to cover its most important routes, including those that integrate with the highways of the System in adjacent states. The Federal Aid Secondary System is meant to be a system of highways serving essentially as feeder roads to the former.

The amount of the regular annual appropriations made available by Congress of highway purposes has varied from time to time. Generally speaking, each state must match evenly the money received and must use the aggregate amount for construction or improvement of eligible highways; the money cannot be used for maintenance purposes.

In addition to the monies apportioned to the states, the Federal government regularly appropriates funds for the construction and maintenance of highways in National Parks and Forests and on other land under its direct control. Furthermore, during emergencies such as the depression of the early 1930's and for the post-war period, special funds have been appropriated for highway purposes.

During the period 1934 to 1943, inclusive, the average annual amounts contributed by the Federal government have been as follows:

Regular funds to States	$217,000,000
Funds for Forest and Park Service, etc.	38,000,000
Special relief funds	437,000,000
TOTAL average annual Federal funds	$692,000,000

Penalty Clause. A penalty clause is incorporated in the Hayden-Cartwright Act to the effect that as much as one-third of its apportionment may be withheld from any state that diverts its highway users' revenue in excess of the diversions established by the laws of the state prior to the passage of the act.

Even though they may be adverse to diversion of highway funds, some people resent the inclusion of this clause in the Hayden-Cartwright Act. They maintain that the Federal government is trespassing on the sovereign rights of the states, because the clause attempts to direct them to use part of their own revenues for specific purposes. On the other hand, if a state should refuse to be so directed, it faces the possibility of losing funds badly needed for its highway purposes. This is one of the vexing problems which would disappear if either diversion were barred or sufficient state funds were available to carry out all the work of the state without using highway users' revenue for other than highway purposes.

TOTAL REVENUES

The total revenues for highway purposes available from Local, State, and Federal Government sources during the period from 1921 to 1948 are shown in the following table. It is in part a condensation of Table HF-1 of the Public Roads Administration (now Bureau of Public Roads), issued in November 1944.

HIGHWAY REVENUES
(in millions)

YEAR	LOCAL	STATE	FEDERAL	TOTAL
1921	$ 737	$ 196	$ 81	$ 1,014
1922	776	207	82	1,065
1923	806	263	84	1,153
1924	883	290	100	1,273
1925	1,015	457	102	1,574
1926	1,123	514	95	1,732
1927	1,264	598	93	1,955
1928	1,268	666	96	2,030
1929	1,250	829	93	2,172
1930	1,315	870	146	2,331
1931	1,136	891	202	2,229
1932	863	797	198	1,858
1933	669	738	307	1,714
1934	588	764	669	2,021
1935	590	783	554	1,927
1936	608	871	1,038	2,517
1937	600	1,010	790	2,400
1938	636	996	1,079	2,711
1939	657	1,023	929	2,609

YEAR	LOCAL	STATE	FEDERAL	TOTAL
1940	629	1,103	751	2,483
1941	575	1,225	537	2,337
1942	499	1,106	330	1,935
1943	417	968	185	1,570
1944*				
1945	522	1,162	74	1,758
1946	620	1,605	172	2,397
1947	635	1,673	325	2,633
1948	655	1,916	397	2,968
TOTALS †	$21,336	$23,521	$9,509	$54,366

* Complete data for 1944 are not directly available.
† Omitting 1944.

DISTRIBUTION OF STATE REVENUES

State revenues for highway purposes are used in part directly for collection and administration of revenues, for the construction, improvement, and maintenance of state highways, for policing of highways, and for debt service on outstanding state highway obligations. Another part is used for local road purposes, the money generally being transferred to the local governments according to rules prescribed by the Legislature, in which case the work is carried out by the local governments subject to the approval of the state. However, in some states the work done on local roads with state funds is carried out directly by the state. As previously stated, a part of the revenues are used for other than highway purposes.

In 1943 the disbursement of the state revenues was distributed as follows:

STATE USE		
Collection and Administration	$ 44,254,000	
State Highways	520,282,000	
State Highway Police	30,641,000	
Interest on State Highway Debts	58,278,000	
Retirement of State Highway Debts	119,631,000	$773,086,000
LOCAL USE		
Local Roads and Streets, by State	$ 53,959,000	
Fund Transfers to Local Governments	254,951,000	
Debt Service on Local Roads	6,610,000	315,520,000
Non-Highway Purposes	$152,888,000	152,888,000
TOTAL		$1,241,494,000

DISTRIBUTION OF FEDERAL FUNDS

The Bureau of Public Roads administers the Federal funds apportioned to the several states. Each State Highway Department prepares plans and estimates for the projects it proposes to carry out with Federal aid on state highways, as well as on local roads where the work on these is performed by the Department. Where the work is done by the local governments, the plans and estimates are presented by them to the State Highway Department, which submits all Federal aid projects to the Bureau of Public Roads for approval, acting as the agent of the latter in matters relating to local roads. When approval is received, the Federal aid money for the project is allocated and the work may proceed subject to the inspection and acceptance of the Bureau.

Although this arrangement might have been conducive of differences of opinion by the parties concerned, particularly as to the standards of road construction acceptable to the Bureau of Public Roads, this organization has carried out its work in such a manner that no problems of consequence have arisen therefrom.

20 THE MOTOR VEHICLE AND THE HIGHWAY: SOME HISTORICAL IMPLICATIONS

BY GEORGE ROMNEY

In his thoughtful and provocative essay, *The Highway and its Vehicles,*[1] Mr. Hilaire Belloc assembled a wealth of historic evidence and prehistoric conjecture to bolster his contention that the road is always the product of the conveyance.

After a study of the origins of wilderness trails in many lands, of military roads laid down by Roman armies, of the paths of pilgrimage resulting from the extensive travel in the times when the Papal Court was the supreme court of appeal in Christendom, of the turnpikes and post roads of more recent centuries, and of the railways and the modern motor highways, this eminent British historian concluded: "It was the Vehicle that made the Road. It was the Wheel that made the Vehicle. But the Wheel having made the Vehicle, and the Vehicle having made the Road, the Road reacted back upon that which made it: and though we cannot say that the Highway has, in changing, created a change in Vehicles, yet we can say that, had it not changed, the new Vehicle could not have come into being." [2]

In his examination of the interaction of the modern vehicle (the automobile) and the modern highway, Mr. Belloc centered his studies on the motor roads of England and the Continent. There is no evidence in his work that he gave much thought to the development of motor vehicles and highways in the United States. Had he done so, he could have added considerable fascinating information about the interplay of the vehicle and its creature, the roadway. For, if one compares the parallel developments of railroad and automotive transportation in the United States and in the Old World, one immediately discovers vast differences which have had far-reaching effects.

These differences, whose effects are incalculably extensive, are partly attributable to the geographical dissimilarities of the two areas under consideration. They are also partly results of differences in the braking effect of routine, or the "drag of habit," which affects even the most rapid changes. This latter contrast is most clearly

[1] Hilaire Belloc, *The Highway and its Vehicles*; edited by Geoffrey Holme (London, 1926).
[2] *ibid.*, 27.

evident when the parallel developments of European and American railroads are examined.

Although it may seem to be paradoxical, it is indeed true, as James R. Doolittle said, that the automobile is the ancestor of the locomotive, rather than its descendant.[3] As he pointed out, the steam-powered road vehicle with which Captain Nicholas Joseph Cugnot experimented with some success between 1760 and 1770 was essentially an automobile, designed as a tractor for artillery for the French army. It not only preceded the earliest locomotive, but was the third of the Cugnot experimental vehicles which undoubtedly had more than a little effect upon the early experiments in steam engineering which James Watt conducted at Glasgow University after 1755. As Doolittle observed, "it should be remembered that Watt did not build engines for commercial use until he became associated with Matthew Boulton . . . in 1774," and that the final and successful vehicle of Cugnot's design was built and extensively tested at least four years earlier.

There is ample historical proof that the early experimenters with engine-powered vehicles were thinking of their inventions in terms which we of today would call "automotive," i.e., as means of highway transportation. Both in Europe and in the United States, these experiments were channeled into other directions because of the inadequacies of the roadways which the experimenters hoped to employ. In both areas, the Vehicle had eventually to make its own Way, the railed way, or railroad, as it came to be known. And, in each of the separated areas in which this roadmaking-by-vehicles was in progress, the progress was peculiarly characteristic of the particular area. In England, for example, separation of the existing common roads from the new railed ways was adopted much earlier than was deemed necessary in the United States, where grade separation is still being promoted.

The "drag of habit" had widely different effects also, both on the vehicles and on the ways. In Europe the railway carriage remained, in fact as in name, a carriage. As Mr. Belloc observed, "Until the corridor carriage came in, quite recently, the railway carriage was, through something like a lifetime, nothing more than a series of 'stage coach insides' tacked onto one another; and to this day the railway coach in its very name, in its general plan, the width of its door, its height and the calculation of room in it, derives from the stage coach."[4] So, he adds, does much of the terminology of

[3] James R. Doolittle, *The Romance of the Automobile Industry* (New York, 1916).

[4] *op. cit.*, 33.

European railway travel, such as the words, *booking office, guard, driver,* and *goods wagon,* which in the United States have been from the start *depot, conductor, engineer,* and *freight-car,* respectively.

Though noticeable in the development of the railway, the differences between the Old and New Worlds are startlingly apparent when one considers the fifty-odd years in which the motor vehicle and its roadway developed.

In Chicago, in the fall of 1945, there was a re-enactment of the first automobile race in the United States, an event that created little save local interest when it occurred on Thanksgiving Day of 1895. In consulting the records and contemporary comment on that historic event, researchers of the Chicago Museum of Science and Industry discovered that the primary aim of H. H. Kohlsaat in fostering the original race was to attract public attention to the deplorable dearth of roads in the United States. That Kohlsaat's interest in self-propelled vehicles was a secondary one, and almost an after-thought, is clearly shown by his editorial comment in the *Chicago Times-Herald,* the sponsoring newspaper. In the early stages of the Kohlsaat newspaper's campaign, the emphasis was all on the need for better roads, with frequent references to the fact that the superior roads of the British Isles and Central Europe were working to the advantage of European experimenters in the development and perfection of horseless carriages.

The famous Chicago contest itself demonstrated the truth of the Belloc thesis that the Vehicle makes the Road and is then reacted upon by that which it created. For, of the several vehicles based on foreign design which were entered in the contest, not one was successful. The most successful entries were uniquely American in concept, being in substance nothing more than the familiar horse-drawn vehicle of the American countryside, but propelled either by electric motor, steam engine, or internal combustion engine.

Charles B. King, who participated in that first American race, has observed that, in the years immediately after that event, the type of motor vehicle which was being adopted in Europe became the prototype which most American inventors strove to imitate. That line of development, he added, continued until around 1905, when the conflict between the European vehicle and the American road caused the automotive innovators of the United States to revert to their original ideas and strive to design automobiles along the lines of horse-drawn vehicles which had demonstrated their effectiveness in the road-less United States.

F. E. Moskovics, another of the pioneers who participated in the early endurance contests of horseless carriages, recalled that the

contest between the American and European types of gasoline-powered vehicles began to take pattern along definite lines around 1902. Describing the mechanical differences between the two types in a paper presented at the Chicago Section Meeting, Society of Automotive Engineers, on November 13, 1945, Mr. Moskovics pointed out that the air-cooled engines which several American innovators employed in their vehicles in their attempts to cope with our peculiar highway conditions "blazed the pathway for the present efficient aeronautical air-cooled engines." Between 1904 and 1909, he added, the road races and endurance contests between the two types brought the designers and engineers of the burgeoning European and American industries into such frequent contact that, as a result of exchanged ideas, technology began to displace the guesswork of the earlier years and the modern automobile began to take shape.

Many of the differences that exist today in the modern European and American motor vehicles are traceable to the vastly different ways in which the Old World's highways and the New World's roads reacted upon the vehicles.

At the dawn of the 20th century the lack of roads in this country was beginning to strangle the development of one relatively new industry which had only a few years previously shown great promise. Only three years after the appearance of the "safety" bicycle in 1887, the demand for these novel machines had become so great that twenty-seven factories were making them. Ten years later, more than three hundred factories were required to keep up with the American people's demand for more than a million bicycles a year. Although an incipient good-roads movement was supported at the turn of the century by bicycle manufacturers, cyclists, and carriage manufacturers through such organizations as the League of American Wheelmen and the National Carriage Builders' Association, most of the nation remained so deeply mired in the mud that, in contrast to France and Germany, our land was as backward as some of the Balkan countries.

The road-less condition of the United States at that time is perhaps best illustrated by citing a response to an inquiry which was sent to our War Department by the editor of the book, *Mechanical Traction in War.*[5] This book, by a German military officer, appraised all the experiments which the military organizations of the major nations had conducted in connection with the use of engine-powered traction devices in warfare or maneuvers. Although it was

[5] Lt. Col. Otfried Layriz, *Mechanical Traction in War* (London and Philadelphia, 1900).

thus established that the British had successfully employed steam-powered road-vehicles as early as the Crimean War and that the Prussian Army's use of such equipment in transporting supplies had been a decisive factor in one of the battles of the Franco-Prussian War, the author was unable to find any evidence of American military experiment in this field. The reason for this was revealed by the simple statement with which Brigadier General John M. Wilson, Chief of Engineers, U.S. Army, replied to the inquiry on April 21, 1900: "So far as I can learn, road traction engines have never been seriously considered as a means of army transportation by any Department of our government, probably because the want of good roads in the countries where our military operations have heretofore been carried out preclude their successful operation." [6]

It is interesting to observe that only two days after this letter was written a great public demonstration and trial of motor vehicles was staged in England. This was the Thousand Miles Motor Trial which began at London's Hyde Park Corner. Of this test, the London *Daily Mail* editorialized that among "the broad issues" which the demonstration had made "plain to the intelligent observer was the undoubted victory of petroleum spirit as the motive force for self-propelled road vehicles over all other agents. . . . The two steam cars that ran did not at any time suggest the displacement of petrol. . . . Electric motors—which have neither vibration nor smell, and are therefore preferable—are at present impossible for long distances." [7]

In other words, in Europe the new vehicle, which had earlier been unable to adapt itself to the existing roads and had therefore been forced to create its own railed-road, was at long last transforming itself into something which *could* use the existing highways. And in the United States, as Mr. King observed, this new vehicle, as it was then being perfected in Europe in conformance with local highway conditions, was beginning a struggle with American "roads"—an unequal struggle which was to end with the failure of purely European car-design concepts in the United States and the consequent development here of uniquely rugged automotive design and peculiarly American highway-construction concepts.

In passing, it should be noted that the American need for vehicles capable of negotiating unpaved ways was to become a deciding factor in motorized warfare in the future; for, as Christy

[6] *ibid.*, 95-96.

[7] Quoted *ibid.*, 98.

Borth observed in tracing the origins of military vehicles in *Masters of Mass Production,*[8] the efforts of Otto Zachow, a Wisconsin blacksmith, to adapt his 1906 Reo for its contest with the mud of country roads resulted in the development of all-wheel-drive mechanisms which were to play important roles in World War I and World War II.

In the United States, the lack of roads gave definite and clearly discernible shape to the development of the motor vehicle and to the industry with which the American people subsequently captured world leadership. Here, also, the peculiarly American vehicle can be said to have made the road—a peculiarly American kind of road.

The modern American highway is unique in most of its aspects. Like the vehicles that created it, it is the product of the people, a thing made by the people for the people. Our motor vehicles, in contrast to those of European nations that preceded us in this field, are mass-produced for use by the masses instead of being tailored by "file-and-fit" handicraft methods for use by the classes, or the carriage trade. Similarly, our highways are tending more and more to become products of what one might call mass-construction methods, with such special-purpose machines as bulldozers and similar earth-moving machinery participating in a kind of assembly-line process of highway-laying in which motorized and mobile cement-mixers perform functions not unlike those of the moving conveyors in mass-production factories.

Our mass-produced highways have become as marvelous to the rest of the world as have the mass-produced vehicles that use these people's roads. Like our vehicles, our roads—and the methods for their production—have been sedulously imitated, with signal lack of success.

A notable example of such failure is presented by the case of Germany, under the Third Reich of Adolf Hitler. After careful study of American production and construction methods, the master-planners of Germany's National Socialist Government drew up elaborate plans both for production of the *Volkswagen,* or "People's Car," and for construction of the *Autobahnen,* an elaborate network of the most modern kind of motor-highways. Widely advertised in the late 1930's as means for motorizing the masses of Germany, these devices were the result of deliberate bureaucratic planning, rather than the end-products of that interplay of related forces which, as Mr. Belloc holds, govern the nat-

[8] Christy Borth, *Masters of Mass Production* (Indianapolis, 1945).

ural evolution of the vehicle and its road. The irony of such master-planning obtrudes from the fact that, when the real test came, the *Volkswagen,* though revealed to have been actually devised as a military vehicle, failed in contest with the military adaptations of automotive vehicles which the American people turned out; and the *Autobahnen,* though carefully built by *Organization Todt* as a device to implement the speedy conquest of neighboring nations, became the ideal means for the quick dismemberment of the German military machine in 1945.

The German failure, by itself, seems to show that long range planning by central authority may not only have totally unwanted results but, if not motivated by the most unimpeachable of intentions, results which are terrifyingly contrary to the fondest hopes of the planners. For, in Germany's case, although the planning was undoubtedly initiated by leaders who hoped thereby to improve the common welfare and guarantee the security of the nation, the end effects were exactly contrary to the hoped-for goals.

In sharp contrast is our own nation's hit-or-miss or trial-and-error procedure—in relation both to the vehicle and the highway. From the beginning of this development around the turn of the century, we have been inclined to move slowly and cautiously in this business of lifting our nation out of the mud. For, although we have made rapid strides to a position of world leadership in the production and use of automobiles and motor highways, this rapid advance has in paradoxical fact been the result of forces which demonstrably derive from the most cautious, conservative, and slow-to-change elements in our nation's make-up.

As David L. Cohn observed in *Combustion on Wheels,*[9] although we pride ourselves upon our receptivity to mechanical innovation, and although we needed automobiles much more than any other people on the face of the earth, this mechanical innovation was invented by Europeans. Furthermore, he pointed out, it was the American farmer and the country doctor, two of the most conservative elements in our population, who accepted the motorcar as a utilitarian vehicle "when it was still looked upon as a fad by the city slicker."

It is a matter of historic fact that virtually nothing came of the early good-roads plans until 1907, when the National Grange entered the movement to get the nation's rural dwellers out of the mud that isolated them from all social contacts for part of each

[9] David L. Cohn, *Combustion on Wheels* (Boston, 1944).

year. As Mr. Cohn entertainingly described it, the American farmer and the American country doctor were together responsible for both the great popularity of Mr. Henry Ford's homely but very efficient "Tin Lizzies" and the consequent popular acceptance of the good-roads programs initiated after that strictly utilitarian transport-tool began to be a commonplace on the rural roads of the United States.

This rural acceptance of mechanical novelty is humorously illustrated by an anecdote reported by Franklin M. Reck in his booklet, "A Car-Traveling People." [10] When a farm wife was asked by a U. S. Department of Agriculture investigator why the family owned a car when it did not own a bathtub, the woman replied in genuine surprise: "Why, you can't go to town in a bathtub!"

In the years prior to World War I, the good-roads movement in the United States received the support of many organized segments of our population; the Lincoln Highway Association, one of the most powerful of these organized efforts, was launched and nurtured by the motor vehicle manufacturers. But it was not until after the end of that conflict that the process of vehicle-making-the-road became glaringly apparent.

The process may be said to have begun when the motor truck, as devised and developed by American ingenuity, demonstrated its ability to perform beyond the pavements of the urban streets for which all early trucks were intended. This demonstration was forced by the exigencies of warfare.

In 1911 the United States Army began experimenting with all-wheel-drive automotive equipment which, as we noted above, had been generated by a Wisconsin blacksmith's effort to operate his car in almost road-less territory. In 1912, eleven makes of trucks were put through a gruelling cross-country test of 900 miles over the worst possible terrain, from Washington, D. C., via Atlanta, Georgia, to Sparta, Wisconsin. The only vehicle to reach the finish line was an all-wheel-drive truck which the Army report approved as "the only truck that might be considered for use in field and supply trains." The report added that such a vehicle was "fully capable of replacing the escort wagon and ambulance now used."

After 1914, as World War I began to bog down in the mud, the Allies began to look to the United States for automotive vehicles capable of off-the-road performance.

Although automotive warfare may be said to have had its be-

[10] Franklin M. Reck, *A Car-Traveling People* (published by the Automobile Manufacturers Association, 1945).

ginning with the unorthodox use of taxicabs by General Gallieni to transport Paris garrison troops to the front for the surprise French victory at the first Battle of the Marne, the first deliberately planned large-scale use of motor vehicles as engines of war occurred in March 1916. This was when an advance column of the United States Army crossed the international line at Columbus, New Mexico, on a punitive expedition against Pancho Villa, followed by the first of 74 motor truck trains that participated in that campaign.

By midsummer of 1916 the French, desperately defending Verdun in the face of the prolonged and deadly German offensives, were maintaining contact with the embattled fortress with motor vehicles alone. All railways to Verdun having been destroyed by continuous artillery fire, the sole lifeline to the garrison was the Voie Sacrée, a 34-mile stretch of battered and blasted highway to Bar le Duc. Some 6,000 trucks, many of them of American manufacture, participated in that defense.

That conflict also stimulated human inventiveness into another ingenious application of motor vehicles to off-the-road employment. When the German submarine blockade brought the people of the British Isles to the brink of starvation at the end of 1916, the British turned in desperation to the automotive and farm-equipment industries of the United States for aid in augmenting the production of their limited acres through the use of tractor-powered farm machines. In this automotive field, American ingenuity had evolved the crawler-traction principle, a device which enables the vehicle to make its own highway as it progresses. This phenomenal principle, borrowed from the American farm tractor, was embodied in 1916 in an armed and armored vehicle by the British engineering officers, Ernest Dunlop Swinton and Maurice Paschel Hankey, for use as a trench-crossing machine. Manufactured in great secrecy and given the camouflage name "tank," it was flagrantly misused at first but eventually achieved a breakthrough in the Somme sector on that historic August 8, 1918, which General Erich Ludendorff signalized in his memoirs as "the black day of the German Army."

As a result of the rapid motorization of warfare in those four years of war, mass production of automotive vehicles of all kinds reached such high rates of output in the United States that our nation's need for highways became a screaming urgency as World War I drew to a close. When the fighting ended, the American people possessed a great potential capacity for building motor vehicles in unprecedented numbers, but virtually no capacity for their use. Truck production, especially, had been greatly stimulated by the

needs of war; and it was this fact which unexpectedly brought about the correction of our national plight.

By the middle of 1919, the surplus military motor vehicles had piled up into a baffling disposal problem. The War Department had on hand an accumulation of about 180,000 vehicles in all conditions. Of these, some 146,000 were trucks and trailers. Naturally, wholesale dumping of such a large quantity of vehicles would have had ruinous effect upon the companies that had made them; for our truck-manufacturing industry was then virtually in its infancy, and wholesale release of the surplus at prices below costs would have strangled the infant in its crib. Government machinery for the disposal was therefore created. Vehicles that had been sent abroad were allowed to remain. Sold to Allied nations at prices far below cost, they were used principally for reconstruction of war-ravaged areas. Ten years later, about 18,000 such vehicles were still in service abroad, and their performance had given American manufacturers an excellent reputation in all the countries in which they were used.

Distribution of the domestic surplus was not so easy. Of the 30,849 trucks and 5,503 passenger cars on hand in April 1919, the War Department was authorized to allot a total of 5,704 vehicles to the Post Office Department and 780 to the Public Health Service, both of which were thus started on the road to motorization. But the most important beneficiary was the American people themselves; for what the people eventually got out of the distribution was nothing less than the world's finest network of highways. By 1919 the Bureau of Public Roads was engaged in an expanding program of highway improvement through Federal monetary grants to the states. Under this program, then getting under way, highway officials of the states saw that grants of automotive equipment and road-making machinery would be of more immediate use than money. Thus, by mid-summer of 1919, the Bureau had accumulated requests for thousands of vehicles, most of them trucks. In all, the War Department disposed of 27,983 vehicles in this manner alone.

Here we have a concrete case of the vehicle making the road, not figuratively, but actually. For, with these vehicles that had been designed and built for warfare, the American people began the huge physical task of lifting the nation out of the mud with a system of motor highways.

The vehicles were subjected to almost endlessly various and ingenious modifications and adaptations. Ambulances became portable offices for construction engineers; tank trucks became sprin-

klers; military supply trucks were fitted with dump bodies and hydraulic and mechanical hoisting devices; and, in many cases, trucks that had been converted to haul roadbuilding material were also fitted with blades which transferred them into scrapers, or plowshares that were used for snow removal. "The beneficial effects of the distribution of this material can scarcely be estimated," said the Chief of the Bureau two years later.[11]

In the next two decades the seeds thus broadcast germinated into innumerable benefits. A whole broad range of earth-moving and pavement-laying machinery developed as one result. The techniques mastered in the process of developing and using such machinery figured importantly, not only in promoting highway development, but also in making possible those unprecedentedly huge operations whereby the nation's rivers were harnessed by some of the greatest dams ever constructed.

Later, when the nation had to hasten to rearm itself for World War II, such automotive machinery, developed primarily for highway construction, played an important part in the rapid creation of the factories, airports, docks, shipyards, pipelines, and fortifications which were built in virtually every quarter of the earth. In that larger conflict of the 1940's, the mass-construction techniques, which Americans had mastered as a result of their two decades of the greatest highway-building activity in all history, were demonstrated to such good effect that, the world around, the crawler-tractor bulldozer—a plowshare-equipped automotive vehicle carrying its own highway—became the most commonly accepted symbol of the American at work.

What of the future? As a nation, we have lifted ourselves out of the mud—and into a muddle. As modern as it is, and as relatively free as it is of the "drag of habit," our highway system is antiquated and inadequate. The muddle is particularly acute in our larger urban centers and their environs. The muddle can undoubtedly be expected to be a continuing feature of our way of life as long as our nation's growth continues; for growth is change, and change makes impermanent even those physical things which seem most permanent. Our motor vehicles and the roads which they have created have brought us unprecedented mobility. The rapid drift of population from rural areas to urban centers, which alarmed social students in the 1920's and 1930's, has been countered by a noticeable drift in the opposite direction. Our cities are "exploding"

[11] Irving Bernstein, *The Automobile Industry—Post-War Developments, 1918-1921,* Bureau of Labor Statistics, U. S. Department of Labor, Historical Study No. 52, September, 1942.

their populations and their industries ever farther into their surrounding areas. The range of the individual American's mobility in his day-to-day activity is multiplying. Under the impact of such drift and counter-drift, it is inconceivable that our nation's highway network shall soon settle into a fixed, inflexible, habit-burdened system. For we Americans are inherently the most restless of people; and, as long as this trait is dominant in us, our land shall doubtless continue to provide the ideal climate for the Vehicle's road-creative proclivity—whether the Way dictated by the Vehicle be waterway, railway, highway, airway, or some other way not yet comprehended.

21 THE RELATION OF THE HIGHWAY TO RAIL TRANSPORTATION

BY JULIUS H. PARMELEE AND EARL R. FELDMAN

Prior to the coming of the steam railway, land transport in the United States was conducted wholly by highway. This type of transport was slow, irregular, and costly, so much so that early railroad development received much of its impetus from the desire of many communities to improve their means of communication with each other.

Railways entered the transportation field about 1830. They developed rather slowly at first, and for the most part in the East and South. By 1860, some 30,000 miles were in operation. Completion of the first line to the Pacific Coast in 1869 marked an historic forward step, and railroad mileage grew rapidly from that time up to its peak of 254,000 miles in 1916. Incidentally, the railroad mileage of the United States is nearly one-third of the aggregate mileage of all countries of the world combined.

RAILROADS AND HIGHWAY DEVELOPMENT

During the period of railroad mileage growth, from 1830 to 1916, highways served largely as feeders to the railroads, bringing to the railhead the raw materials and produce destined for other sections. Similarly, finished goods were shipped from factories by rail, and received highway handling largely as a local matter, factory to railway station at point of origin, and railway station to dealer or final consumer at point of destination. Thus to a great extent the two means of transportation were complementary.

The railroads are and have been for many years interested in the improvement of feeder roads. Because such improvement reduces the initial cost of carrying produce from the farm and carrying goods back to the farm, rail carriers have not objected to being reasonably taxed for the improvement of farm-to-market roads. In 1901 the first "Good Roads" trains were inaugurated, with the cooperation of railroad officials and manufacturers of road machinery. The Illinois Central Railroad ran such a train in that year between Chicago and New Orleans at an estimated cost of from 40 to 50 thousand dollars for a three-month period. In the same year, "Good Roads" trains were operated also by the Lake Shore and Michigan Southern

and by the Southern Railway. Later, such trains were run by other railroads, and the railroads continued to encourage the improvement of public highways.

AUTOMOTIVE DEVELOPMENT SINCE 1916

By 1916, however, highways and highway traffic were beginning to have an effect on the movement of persons and goods from city to city, over short distances, as well as locally. Both private automobiles and trucks were increasing their radii of operation, and the bus was making its appearance. Highway competition for intercity traffic, although at that time in its infancy, was destined to grow increasingly important with the years.

A weighty factor in this development was the Federal Aid Program for highway construction, inaugurated in 1916 with a modest appropriation of $5,000,000 for the fiscal year ending June 30, 1917. Even before that program started, rural roads had been receiving much attention, under the incentive of the popularity of the automobile.

From 1916 to 1946, great progress was made in the development of highways and the motor vehicle. State highway departments and local road administrators, aided by gasoline taxes, registration fees, property taxes, and Federal-aid appropriations, built and rebuilt hundreds of thousands of miles of rural roads. Annual expenditures on rural highways alone (excluding city streets) attained a peak during this 30-year period of $1,760,000,000 (in 1938) of which amount $372,000,000 was Federal aid. During the peacetime years between the two world wars, an annual average of more than $2 billion was expended in the United States on highways and streets, whereas highway-user revenues averaged only $700 million annually.

Highway-user payments have been expended largely upon rural improvements. Less than 10 per cent of such payments have been expended on urban streets, despite the fact that almost one-half of the revenues received from motor-fuel taxes and vehicle-license fees is derived from traffic using urban streets. This has caused an over-development of rural trunk line highways, with consequent under-development of facilities to handle urban traffic. Present street traffic congestion is the result.

During this development period, from 1916 to 1946, the highway and the motor vehicle operating on it assumed a dual role: that of feeders to the railway, a function they had already performed since 1830, and, in addition, that of carriers of intercity freight and passengers on their own behalf.

EFFECT ON THE RAILWAYS

With this brief introduction, we may consider the effect of highway and motor vehicle development on the railway, what is their relationship today, and what the future of such relationship should be.

So far as its effect on railroad traffic is concerned, highway and automotive development has operated in two directions. First, it has brought the railways freight traffic that would not otherwise have moved. Second, it has diverted freight and passenger traffic away from the railroads that would otherwise have moved by rail. The net effect of these two influences, working in opposite directions, is not easy to determine with exactness, but is believed to be negative, as the following brief analysis rather clearly indicates. In other words, the railroads have almost certainly lost more—taking both freight and passenger traffic into account—than they have gained, as a result of the tremendous highway and automotive development.

TRAFFIC CREATED FOR THE RAILWAYS

Beyond question, development of highways, motor vehicles, and motor vehicle use has created a considerable volume of freight traffic for the railways that would not otherwise have moved. True, had the automotive industry not grown to the dimensions it has attained, other industries might have expanded and supplied the employment and utilized the products absorbed instead by automobile and highway construction and use. Thus they would have furnished railroads with traffic which their disappearance or failure to expand prevented. This is a somewhat speculative field, a survey of what might have been, which it is perhaps unnecessary to explore in detail.

It is true, also, that to some extent automotive products have merely superseded other products now in much less demand than formerly, because of the motor vehicle. Examples are the production of carriages and wagons, harness, horseshoes, certain animal feeds, and the like. On balance, however, automotive development has probably created more rail freight traffic than it has thus superseded.

Estimates of the volume of railroad traffic to be credited to automotive development cannot be made with exactness. Many estimates have been made, varying up or down according to the point of view of the estimator. The Automobile Manufacturers Association has made estimates from time to time, as to the total number

of carloads of what it calls "automotive freight" handled by the railroads, and the freight revenue derived therefrom.

This automotive freight, as defined by that association, consists of motor vehicles and parts, gasoline and crude petroleum, lubricating oil, road and fuel oil; also construction materials for motor vehicles and for highways, such as iron and steel, lumber, crude rubber, cement, asphalt, gravel, sand, stone, brick, and other similar items.

In its annual publication known as "Automobile Facts and Figures," 1942 edition, the Automobile Manufacturers Association estimated that the railroads in 1941 handled 4,357,612 carloads of all classes of "automotive freight," from which they derived a freight revenue of $530,503,177. Inasmuch as railroads of Class I in 1941 originated a total of 31,705,818 carloads of carload freight, from which they derived a total of $4,317,978,117, the automotive freight estimated by the automobile industry represented 13.7 per cent of the total carload freight handled in that year by rail, and 12.3 per cent of the total rail freight revenue. As already indicated, this freight was in part a displacement of the movement of other commodities that would have moved by rail, had the automotive industry not developed as it has during the past thirty years.

TRAFFIC LOST TO THE RAILWAYS

On the other hand, it must be recognized, and automotive interests themselves agree, that development of highways and the motor vehicle has diverted considerable traffic and revenue away from the railways, traffic which now moves by highway instead of by rail.

Not all of the intercity traffic of commercial motor trucks and buses can be regarded as having been diverted from the railroads. Some of this traffic is in a sense new, such as would not move by rail in any event. Another portion moves over routes not served by rail and is to that extent non-competitive with the railroads. While no definite allowance can be made for these factors, highway traffic has cut materially into railway freight and passenger traffic, and it is beyond question that this decrease is greater than any new business that the automotive industry has brought to the railroads.

FREIGHT TRAFFIC TRENDS

Even casual consideration of the trends of freight and passenger traffic by rail and highway in the United States supports the views just expressed. Studies and estimates of the Interstate Commerce Commission give figures for intercity commercial freight traffic in

the United States by rail and by highway, respectively, in the years 1926 and 1941. The year 1926 was the first for which the Commission made such estimates. The year 1941 is here taken for comparison, because it was not greatly affected by wartime developments from 1942 to 1945, which temporarily restricted highway movement and tended to throw an unusual volume of traffic on the railroads.

The distribution is as follows, stated in terms of ton-miles of freight movement.

DISTRIBUTION OF COMMERCIAL FREIGHT TRAFFIC
BY RAIL AND HIGHWAY
Ton-Miles (*in millions*)

	RAILROADS	TRUCKS	TOTAL
1926	450,644	23,530	474,174
1941	480,783	57,123	537,906
Increase:			
Amount	30,139	33,593	63,732
Per cent	6.7	142.8	13.4

These statistics include all commercial movements of freight, whether by common carrier, contract carrier, or private carrier.

They show clearly the rapid growth of commercial highway freight traffic from 1926 to 1941, the increasing proportion of total rail-plus-highway traffic moving by highway, and the decreasing proportion moving by rail. The railroads showed an increase in volume of 6.7 per cent between 1926 and 1941. At the same time, motor truck traffic increased 143 per cent. As a result, the railroad proportion of total rail-plus-truck traffic decreased from 95.0 per cent in 1926 to 89.4 per cent in 1941, whereas the truck proportion more than doubled, rising from 5.0 per cent in 1926 to 10.6 per cent in 1941.

A complete and exact estimate of traffic diverted from the railroads by motor carriers of freight cannot be made, since necessary data do not exist. Among other products, heavy losses have been experienced in the movement of agricultural products, such as diversion from rail to highway of carlot shipments of livestock. Other agricultural products now largely trucked into the principal markets are milk, butter, eggs, fruits and vegetables, and both live and dressed poultry.

The inroads made by motor transport can be indicated by the facts developed in a recent specific study. The study pertained to the total production of poultry and dairy products in Arkansas, Kansas, Missouri, Oklahoma, and Texas during the period 1929 to 1939,

inclusive, and the percentage of such production transported in carloads by a southwestern railroad during the same period. The study showed that the railroad loaded 34.6 per cent of the 13,229,000 pounds of cheese manufactured in the five states in 1929, but only 2.7 per cent of the 45,775,000 pounds manufactured in 1939; that the railroad loaded 12.7 per cent of the 196,531,000 pounds of butter manufactured in 1929, but only 3.5 per cent of the 258,891,000 pounds manufactured in 1939; that rail carloads of dressed poultry declined from 921 in 1929 to 589 in 1939, although the number of chickens and turkeys raised in the two years was approximately the same; and that the percentage of eggs loaded on the railroad declined from 5.0 per cent of the eggs produced in 1929 to 1.5 per cent of approximately the same production in 1939. There is every reason to believe that the decline in railroad loadings was caused largely by highway motor transport competition.

PASSENGER TRAFFIC TRENDS

The Interstate Commerce Commission has also made estimates of the volume of intercity commercial passenger traffic by rail and by highway. The statistics for 1926 and 1941, in millions of passenger-miles, are shown in the following table.

DISTRIBUTION OF COMMERCIAL PASSENGER TRAFFIC BY RAIL AND HIGHWAY

Passenger-Miles (*in millions*)

	RAILROADS	BUSES	TOTAL
1926	35,673	4,375	40,048
1941	29,406	13,646	43,052
Increase:			
Amount	(*D*)6,267	9,271	3,004
Per cent	(*D*)17.6	211.9	7.5

These passenger statistics cover only for-hire travel, and exclude the movement of passengers in private passenger automobiles, whether such movement is for pleasure, for personal reasons, or for business purposes.

Similar but more striking trends are thus to be found in the passenger than in the freight carrying field. In terms of passenger-miles, the railroad total decreased 17.6 per cent between 1926 and 1941, whereas the bus total increased 212 per cent. As a result, although the rail-plus-bus aggregate was only moderately greater in 1941 than in 1926, the railroad proportion was 89.1 per cent in 1926, and decreased to only 68.3 per cent in 1941. At the same time, the

bus proportion nearly tripled, going from 10.9 per cent of the total in 1926 to 31.7 per cent in 1941.

The showing for passenger trends is much worse for the railroads than that indicated in the foregoing table, because a large part of the passenger traffic formerly going by rail now moves by private passenger automobile, and the growth of intercity travel by automobile is not reflected in the comparison.

Private passenger automobile travel on all rural roads in 1941 has been estimated at 135 billion vehicle-miles by the U. S. Bureau of Public Roads. Assuming an average of two persons in each car, there is produced the astonishing figure of 270 billion passenger-miles by automobile in 1941 on rural roads. This total was 20 times the volume of travel by commercial bus, 9.2 times the travel by rail, and represents 86 per cent of the combined passenger-mileage of the three agencies. There is no doubt that some of the 270 billion passenger-miles was purely local traffic or would not have moved by any kind of public carrier; how much, is unknown and not susceptible of estimation.

Although comparable statistics for 1926 are not available, the total vehicle mileage on all rural highways in 1921 has been estimated at 22 billion vehicle miles, or perhaps 44 billion passenger-miles. These estimates indicate that from 1921 to 1941 such passenger car travel increased six-fold, from 44 billion passenger-miles in 1921 to 270 billion in 1941. Between the same two years, railroad passenger traffic (all classes of railways) decreased 22.0 per cent, from 37.7 billion passenger-miles in 1921 to 29.4 billion in 1941.

WARTIME AND POSTWAR TRENDS

During the war, or from 1942 to 1945, the railroads recovered a large part of the proportionate traffic they had lost between 1926 and 1941. However, their traffic reached its peak in 1944, both as to ton-miles and as to passenger-miles, and has since decreased. Railroad ton-miles, for example, were less in 1947 than in 1944 by 11.2 per cent, and railroad passenger-miles were less by 51.9 per cent. Further decreases took place in 1948, to be followed by additional declines in 1949.

By contrast, freight traffic by highway has increased. Truck traffic increased from 49.3 billion ton-miles in 1944 to 77.9 billion in 1947, or 58.0 per cent. Bus traffic, however, decreased by 11.7 per cent during the same period.

This brief summary of trends before, during, and since the Second World War makes it clear that the railroads have suffered

severely from the growing competition of the highways and highway carriers. The volume of traffic they have lost from such competition, in both the freight and passenger fields, is undoubtedly greater than the volume they have gained in respect of rail freight traffic created by the development of the highway and the motor vehicle.

THE COMPETITIVE SITUATION

Reference has been made to growing competition between highway and rail carriers. It is proper to inquire whether that competition is conducted by either of the two transportation groups on a basis that is fair and equitable throughout.

This controversial subject has received much attention, and great differences of opinion have developed. Many neutral observers, however, believe that highway users have been and are able to operate on more favorable terms than the railways. They believe, further, that this situation largely grows out of the fact that commercial operators of trucks and buses by highway are not paying their full share of the cost of building and maintaining highways to standards adequate for their use.

A major issue revolves around the question of whether the large and heavy commercial vehicles should be required to bear the additional costs of building highways suitable for their operation, over and above the standards of what would be required for private passenger automobiles.

The highway operator has no investment in the highways over which he conducts his business. He is, therefore, relieved of carrying charges on an important element of his business, and his taxes and other costs based upon property ownership are relatively much less than those of a railroad. A comparison of the actual account of a typical railroad company and the average Class I common carrier of general freight on the highway engaged preponderantly in intercity service is set forth herewith. The comparison shows that the ratio of taxes to gross income in 1942 was 15.85 per cent for the railroad company and 10.25 per cent for the average highway transport company. The average highway carrier's tax (according to I.C.C. records) includes provision for income taxes. Taking into account, however, interest on and amortization of investment in right-of-way, and the cost of maintaining the right-of-way, the railroad ratio increased to 42.89 per cent. These statistics are shown in the following table.

RATIO TO GROSS INCOME, 1942

	RAILROAD	HIGHWAY TRANS. CO.
Taxes	15.85%	10.25%
Interest on investment in right of way (excluding buildings, shops, engine houses, etc.)	7.16	
Amortization of investment in right of way	7.16	
Cost of maintaining right of way	12.72	
TOTAL	42.89%	10.25%

Moreover, the governmental regulation under which highway carriers operate is of a less restrictive nature than that applied to railways.

It is generally recognized that competitive conditions are not equal as between highway and railway carriers, and that until our national transportation policy is fully carried out in that respect, conditions will remain unequal. That policy as enunciated by Congress in the Transportation Act of 1940 specifically provided that there should be fair and impartial regulation of all modes of transportation, so administered as to (1) recognize and preserve the inherent advantages of each; (2) foster sound economic conditions in transportation and among the several carriers; (3) eliminate unjust discrimination, undue preferences or advantages, and unfair or destructive competitive practices; all to the end of developing, coordinating, and preserving a national transportation system, by water, highway, and rail, as well as other means, adequate to meet the needs of commerce and the national defense.

Railroad managements believe in the soundness of this statement of national transportation policy. At the same time, they believe that the policy is not being carried out along legislative and administrative lines. In respect of a number of competitive elements involved in that policy, the railroads have recently taken a formal position, expressed by them through the Association of American Railroads in 1946, in a report to the Committee on Interstate and Foreign Commerce of the House of Representatives.

In that report, the railroads laid down certain general principles that should govern transport competition, followed by a discussion in each case of the reasons why the particular principle was believed sound, and showing how the principle harmonized with the national policy. These principles are as follows:

1. Each agency of transportation should be required to pay its own way, including fair and proper payments for the use of facilities and services provided at the public expense.

2. Each agency of transportation should pay its proper share of taxes for the general support of government.

3. Government expenditures for transportation facilities (such as highways) should be subject to the same tests as to public convenience and necessity, and economic justification, as are applicable to private expenditures for similar purposes.

4. Operation of any two or more different forms of transportation by a single interest, under suitable regulation, should be permitted in the public interest.

5. All carrier regulation should be administered by the same Governmental agency.

To place all transportation agencies on an equal competitive basis will be no easy task, but the problems are not insuperable. So far as highways are concerned, Federal and state governments, by means of license taxes, fuel and oil taxes, and other proper charges, should recover from motor operators all costs fairly assignable to the users of the public highways.

Furthermore, the government should guard against the building of surplus transportation facilities that the country cannot support on an economic basis.

COORDINATION

The statement of national transportation policy, summarized above, specifically refers to coordination among the several agencies of transport. Such coordination is clearly regarded by Congress as in the general public interest. To what extent is coordination actually in effect, as between highway and rail carriers, and to what extent should such coordination be modified, expanded, or reduced?

The answer to this question, if developed in detail, would call for more space than is here available. Briefly, it may be pointed out that the railroads themselves own and operate several thousand motor vehicles, as a part of their own rail and collateral operations. In addition, they have contracts with hundreds of local trucking companies, which carry out for the railroads the functions of collecting and delivering freight within local areas. The freight service is usually termed "pick up and delivery service" rendered by the railroads to their patrons, with respect to package freight. Independent local truckers pick up the shipment at the home, office, or factory of the consignor, and take it to the railway freight station. Railroads then handle the shipment to the destination station, where local trucking service again steps in and delivers the package to the consignee at his home, office, store, or factory.

Similar arrangements have been made in some cases with bus

companies, for collection and delivery of rail passengers along lines similar to those developed by many airlines, which bring passengers to and take them from their respective airports. Such uses of commercial motor vehicles are to a large extent complementary to rail service.

In some coordinated rail-truck services the motor vehicle is loaded on a rail car, transported on an overnight trip by rail, unloaded at a rail point, and delivery of the merchandise is then made by truck either at the rail terminal or to cities and towns within a short hauling distance. Some railroads employ special car equipment to accommodate demountable bodies or steel containers which are adapted to haulage by truck as well as by railroad car, thus making for efficiency in handling.

In addition, a coordinated rail-highway freight service usually involving relatively short over-the-road movements of less-than-carlot freight is rendered for the benefit of the public by many railroads today. This service is typical of coordinated rail-highway freight transport operations as presently practiced—short haul by truck and long haul by rail.

The railroads are, however, restricted materially in the provision of highway freight service by the fact that the Interstate Commerce Commission often lays down stringent conditions and qualifications governing the service. Generally speaking, railroad-owned or controlled motor freight operations are not granted a franchise to conduct a direct common carrier operation, but are limited to the collateral handling of freight that is carried a part of the total distance by rail, or to services that supplant those formerly rendered by rail. Some railroads have found by experience that in order to perform an efficient rail-truck service in the public interest, they should be permitted to handle less-than-carlot freight moving solely by truck as well as by rail and truck.

Under such restrictive conditions, railroads find it difficult to enter highway freight operations of a long-haul nature to any appreciable extent. If they do undertake highway operations under the handicaps laid down by regulatory authority, they find it difficult to operate at a profit. This is not true coordination.

Many railroads are engaged also in a coordinated rail-highway common carrier passenger service. The highway portion of the service is provided by buses operated either by the railroad or its contractor, or by a wholly owned subsidiary or affiliate of the railroad. As a general proposition, passengers may use the buses provided by the coordinated service without making use of the train. The coordinated service is especially adaptable to light traffic rail branch

lines, to a feeder service for off-rail points, and to sight-seeing tours supplementing long rail trips through scenic areas.

CONCLUSION

This brief survey emphasizes the various interrelationships of rail-highway transportation as developed in the United States. Railroads are experiencing more and more the pressure of competition from their highway rivals, both in freight and passenger services. This competition would not be complained of by the rail industry, if it stood on an equal footing. A certain degree of healthy competition is stimulating to any form of business.

But does competition stand on an equal footing? Does each carrier build and maintain its own right of way, or at least contribute a fair proportion of the cost of constructing and maintaining the roadways it utilizes? Is any one carrier subject to more stringent regulations or disproportionately heavier taxes than are other carriers?

Answers to these questions highlight the unfavorable position of the railroads. No other transportation industry is more closely regulated. It is not that this regulation is unfair, in and of itself. The difficulty lies rather in the fact that agencies competing with the railroad are subject to less restrictive regulation, although performing similar public service.

Taxation is likewise inequitable from a competitive standpoint. Railroad taxes are heavy, and contribute in no small measure to general governmental expenses. In addition to the taxes they pay, railroads own and maintain the rights of way on which they operate. Their highway competitors pay taxes, but these taxes are far from being sufficient in amount both to defray highway building and maintenance costs, and to meet the general costs of government.

Railway taxes, as in the case of other general taxes, support schools, police and fire protection, meet other costs relating to the government and even the cost of highway construction and maintenance. The taxes of motor vehicle operators, on the other hand, are used almost entirely on highway expenditures which are of special benefit to them.

Despite vast Federal expenditures on the development of other forms of transport, the privately owned and operated railroads carried the load when war came upon us in 1941. Government authorities have estimated that 97 per cent of all organized wartime troop movements were by rail, while 90 per cent of our military freight traffic was moved by rail.

If the national transportation policy is applied to all transportation agencies alike, and instead of being a mere statement of principle is vitalized into an instrument of effective policy, the railroads believe that each agency—railroads, highway operators, and others—will find its proper field of service, where it can operate with the greatest economy and efficiency. Such a result would be in the public interest, because it would assure the nation the best all-around transportation service, at the lowest economic cost, that private enterprise can render. Until that sound policy is implemented and fully carried out, inequities will continue, to the detriment of the railroads and contrary to the public interest as a whole.

22 HIGHWAYS ON THE EARTH AND IN THE AIR

BY JOHN C. COOPER

ALL types of transport between determined points have three things in common—facilities provided by nature, facilities provided by man, and mobile vehicles. As the latter two have increased in cost and complexity, communication has developed in frequency, rapidity, and convenience, thus adding to the advance of civilization. Originally man carried loads on his back and was his own vehicle. Through the long cycle of discovery and invention, man developed two-dimensional transport. The natural facility in each case was part of the earth's surface, land or water.

When the Wright brothers flew at Kittyhawk a few feet *off the surface* for a few minutes, modern three-dimensional transport came into existence. Navigation in the unguided free balloon had never been transport because man could not determine its destination. Early dirigibles were hardly more satisfactory.

The economics of the relationship of this new form of transport to the older form of highway transport on the earth's surface is still too little known for exact analysis. The development of air transport has been too rapid and too recent to permit more than generalizations in this article. We may consider, however, some of the problems which present themselves to the conscientious government or municipal planner. Both highway transport and air transport require large investment in ground facilities, and this investment is usually derived from public funds. The problem for the planner to determine is this: In what cases and to what extent are the two means of transport supplementary so that both types of investment are justified economically; and in what cases, if any, are they so competitive as to be mutually exclusive?

For the development of modern transport by highway, nature furnishes the surface of the earth—nothing more. Man must survey the route, clear, grade and level the right of way, build bridges, and hard-surface the roadway. Furthermore, all these must be maintained continuously if the original capital investment is to be justified. The automobile, bus, or truck can, in theory, use the highway immediately on completion without further ground investment. In actual practice, however, modern interurban transport requires expensive garage and terminal facilities.

For the development of modern transport by air, nature furnishes

a layer several miles thick in which aircraft can fly above the earth's surface, called (for want of a better name) the "navigable airspace." In this airspace there are no physical boundaries and no shores—just one continuous ocean of air over the entire globe. But to use this freely-provided transport medium, man must provide landing areas on the surface of the earth. As Colonel Hanks expresses it: "An airplane must have real estate on which to land and take off, otherwise there will be no flying. Unlike the automobile, the airplane cannot be parked en route. The one essential factor in the whole aviation structure is that a successful trip must commence and must end at an airport or other ground space. This fact cannot be ignored." [1]

To use this transport medium safely, man must furnish also the complex navigation facilities (radio, weather observation points, traffic control systems, etc.) without which modern air transport could hardly exist. These ground surface facilities are more or less expensive according to the size and type of the aircraft to be accommodated, the volume of traffic, conditions of terrain, and many other technical problems. As in the case of highway transport, facilities must also be provided for passenger and freight terminals and to house the vehicles of transportation (the aircraft). Dr. Edward P. Warner, formerly Vice Chairman of the Civil Aeronautics Board and more recently President of the International Civil Aviation Organization in Montreal, has estimated that a usable air route for modest operations can usually be constructed for a total first cost of no more than two or three thousand dollars a mile as contrasted with ten times that sum or more for a railway or highway.

The objective of any type of transport service is to assist delivery of the "load" from the point of original departure to that of ultimate destination. With the passenger, this may be from his office (not the bus or air terminal) in the city of departure to his hotel or other stopping place in the city of destination. It is quite true that the transport system can ordinarily control the movements of the passenger or cargo only from terminal to terminal. However, the transport system or the municipality can or should so arrange terminal facilities that those facilities are as near as possible to community centers of population. Thus the greatest number of passengers and the largest amount of cargo will be at minimum effective distances from actual business departure or destination points. The term "effective distance" is used intentionally. The effective distance in

[1] Stedman S. Hanks, *Aviation Gets Down to Earth; the Growing Need for Public Landing Fields* (Boston, Aviation Information Service, 1940), 14.

modern business is more apt to be the "time distance" than the "space distance." An airport one-half hour by bus from a community center, although six miles away, is more useful than one only four miles away, if traffic conditions of the latter put the "time distance" at one hour by bus.

In such cases the two types of surface investment are entirely supplementary, and proper planning must consider highway transport and air transport as one interrelated problem. The Civil Aeronautics Administration of the United States Department of Commerce expressed this clearly and concisely: "Probably the most obvious factor influencing the location of an airport is its proximity to the ultimate destination and source of passengers and cargo. In the case of air transport, the ability to cover great distances in a short space of time most often is cited as its outstanding attribute." [2]

Too often airports have been constructed at large expense without much thought as to how the passengers or cargo departing or arriving by air are to be transported between the airport and the real community departure or destination center. Where such airports have already been constructed, urban planners might well find justified the construction of new express highways or other traffic facilities to lessen the time distance to or from the airport. Boston, for example, after building its airport, found it useful to construct a vehicular tunnel beneath inner Boston Harbor, bringing the airport to within two miles by road from the business district, and supplanting original access to the airport through congested city streets and over a slow ferry or a long circuitous routes around an arm of the harbor.[3]

When considering the location of future airports, the urban planner who does not look upon these two types of transport as supplementary is indeed short-sighted. And this goes somewhat further than the mere provision for rapid downtown pickup or delivery.

Express surface highways to neighboring smaller communities are of great importance in providing the highest percentage of usefulness for large airports. It is obvious that airports costing many millions of dollars and designed to accommodate the great passenger and freight aircraft now under construction will be built only in the immediate vicinity of our largest cities. Construction of major air-

[2] U. S. Department of Commerce, Civil Aeronautics Administration. *Airport Planning for Urban Areas* (June 1, 1945), 27.

[3] John W. Wood, *Airports. Some Elements of Designing and Future Development* (New York, 1940), 47. For a recent study of similar questions, see Robert Ramspeck, "Traffic Problems from Air Terminals," *Traffic Quarterly* (July 1948), II, 251.

ports is so expensive that purely financial considerations will necessarily limit their number. Access to such airports from neighboring small communities by fast express surface highways, by building up the business of the entire district, cannot but help indirectly the city at which the airport is located. While it is true that the Federal government has planned a wide extension of airport facilities to smaller communities, it is nevertheless suggested that this does not obviate the advantages of express highways to major airports. Such highways are accessible to every farmhouse or hamlet along the route and no system of supplementary airports would be apt to make such highways useless.[4]

An interesting example is New York City's Idlewild Airport. Its immediate proximity to the Southern Parkway, the existing or planned development of certain expressways and tunnels into midtown Manhattan, and the feeder system of the Queens-Midtown Tunnel, the Triboro Bridge, and the Bronx-Whitestone Bridge, assure easy transit between the airport and the heart of the city in terms of effective distance. There remains one bottleneck—the few blocks between the west end of the Midtown Tunnel and the centers of traffic origin in midtown and downtown Manhattan.

Chicago chose a site for its new airport 19 miles from the city itself. Two factors governed this selection. Any closer location would have caused serious interference between air traffic coming into the new airport and the already existing Municipal Airport. Also, the site was sufficiently far away from the industrial area so that it would not be closed in by smoke or "smog." These advantages plus the present high-speed road connections and plans for a wide expressway running close to the airport site should more than counteract the additional transit time required from the city to the airport.

Up to this point the problem of the planner is fairly clear. When highway transport and air transport supplement one another, those highways which are feeders to express air services are justified in any community planning program.

A more difficult problem appears when *both* highway and air transport systems are simultaneously maintained as separate connecting links between communities. Here highways on the earth's surface and in the air cease to be supplementary and become competitive.

[4] For an excellent early study of the whole airport problem, particularly the functional relation of airports to highways and other means of transportation, see *Airports, Their Location, Administration and Legal Basis,* by H. V. Hubbard, M. McClintock, and F. B. Williams (Harvard City Planning Studies I, 1930).

Such examples are highways planned for construction and maintained over difficult terrain or through sparsely settled country. Several such highways have been constructed under the non-typical conditions of a war economy. To the extent that they are already or can be paralleled by air transport, the problem of their future maintenance becomes acute. Consider the Burma and Stilwell Roads over the Himalayas, and the Alaska Highway from the United States to Alaska. The cost of these highways, due to the military conditions under which they were built, is difficult to analyze or state. These costs are known to have been very large (even with the cheap local labor in the case of the Himalaya roads). The cost and difficulty of maintenance will be great.

Estimates of the over-all cost of building the Stilwell Road range from $125,000,000 to $200,000,000. In wartime this road was considered a necessity, but with the reopening of the land-sea route via Rangoon and Burma's north-south system of river roads and railways, and in view of the cheaper operating costs of air transport over this area, its peacetime economic value is questionable.

The partially-constructed Pan American Highway seems to be needed for various reasons, but whether the tremendous cost of completing and maintaining this highway will be justified by the increased volume of trade and tourists, only time can prove.

The $115,000,000 Alaska Highway, or Alcan as it is known, was apparently never intended to replace existing ocean or air transport routes. Only when the possibility arose that these might be cut off was the Alaska Highway needed to carry supplies. It was used primarily in wartime to connect the various airports on the northwest route to Alaska, and to help in the building and maintenance of the wartime "Canol" pipeline and pumping station system for carrying crude petroleum to the central refinery station at Whitehorse. It also made possible the construction of a long-distance overland telephone system from Alaska to various points in the United States and Canada.[5]

Each of these highways—particularly those in Asia, and to some extent those in the Americas—proceed through difficult terrain entailing large construction and maintenance costs. On none of them will there be important intermediate traffic such as United States express highways pick up through heavily settled country, nor will fuel be easily and cheaply available en route for automotive traffic. In few cases is the intermediate traffic of great volume, and even between terminals it is somewhat limited.

[5] See Herbert C. Lanks, *Highway to Alaska* (New York, 1944).

On each of these routes parallel air transport services exist. As new aircraft appear, air transport costs are being continually lowered and speed and traffic loads increased. It has been recently stated with wide publicity and apparently no challenge that even under war necessity the Burma Road did not carry as much traffic at any time as was flown over the "Hump" by the combined effort of military and civilian transport services. And that was with aircraft much smaller than those soon to become available. The writer is prepared to hazard a prophecy that none of these roads can possibly be maintained for long on a commercially economic basis and that the air will become more and more the preferable highway between their distant terminals.

Air transport in place of highway transport has already been recognized as the better form for development in particular parts of the world. Mr. William A. M. Burden, a former Assistant Secretary of Commerce for Air, in his excellent discussion of the growth of Latin American aviation, says, in referring generally to future development of Latin American transport:

"A considerable expansion of surface transportation can be expected, particularly by highway in areas of flat terrain where road construction is cheap. Major highway-building programs recently completed in Argentina and on the coastal plain of Peru have diverted to cheap bus service much traffic which previously went by air. However, the cost of providing rail or highway connections for literally hundreds of inaccessible communities would be a prohibitive strain on the budgets of even the wealthier countries, because of the vast distances and the formidable physical barriers which must be overcome. To accomplish such a construction program would require decades.

"The airplane seems to provide the solution for this complex transport problem. Usable airports and satisfactory airline service can be established on a large scale in a relatively few years with a much smaller capital investment per mile of route than would suffice for any mechanical means of surface transportation. Moreover, the cost of subsidizing even extensive networks serving small communities should be well within the resources of the larger countries. Finally, expenditures made for this purpose should be easy to justify, politically. They not only develop resources and trade but also draw together outlying regions which in some countries have been politically restless because of their isolation from the national capital and the government." [6]

[6] William A. M. Burden, *The Struggle for Airways in Latin America* (New York, 1943), 177.

In general, the foregoing would seem to indicate that air transport has already developed to a point where the construction or maintenance of surface highways through sparsely settled country and over bad terrain may not be commercially justified, except under special circumstances or military necessity.

An area of doubt also exists in the many other cases to be faced by the highway planning authority. Whether between any two points a new highway is justified, or whether an expensive express highway can be properly added to existing local highway networks, can no longer be decided without considering the air transport potential between the two points in question. When air lines begin to compete in fares with long-distance bus lines plus giving a tremendous saving of time, the whole economic background of our long-distance highway system must be reconsidered.

Air transport will not in our time become a substitute for local surface transport, but the point at which the two become competitive and the further point at which air transport first becomes so superior as to make uneconomic new highway expenditure is a field for the future economist.

Air transport is a new arrival. The extent of its future expansion cannot be predicted with certainty or accuracy. But no future interurban planning will be sound unless the potential usefulness of air highways receives thorough consideration as a part of that planning.

23 FREIGHT TRANSPORTATION ON THE HIGHWAY

BY WILLIAM A. BRESNAHAN

FREIGHT transportation on the highway as we know it today in the United States is a substantial fulfillment of man's age-old need and quest for faster, cheaper and more efficient means of moving *things* from where they are to where he wants them to be. In order to appreciate fully the progress that has been made it is important to bear in mind the fundamental truth that today, as always, highway freight transportation is the sum of the vehicles which carry the freight and the highways over which the vehicles roll.

Early man was his own vehicle—he carried his goods on his back—and his highways were primitive foot-trails. Later he learned that animals could be trained to carry the burden on their backs and still later, following discovery of the wheel, that greater loads could be carried on wagons or carts drawn by animals. For long centuries the animal-drawn wagon continued as man's primary mode of land transportation.

After the horseless carriage had survived its initial ridicule and proved itself more than a mere novelty, its practical value as a means of transportation became obvious. It was a short step from the passenger-carrying automobile to the freight-hauling motor truck. In fact, the first truck, which made its appearance on the streets around the turn of the century, was little more than a converted automobile carriage, with a heavier axle and springs and a strengthened frame.

Feeble as they were compared with the streamlined vehicles of today, the early passenger vehicles and trucks soon were far superior to Old Dobbin. Individuals began replacing their buggies with the new-fangled automobiles, and farmers, draymen and others began hauling to market their produce and freight in gasoline-powered trucks.

Quite naturally, the advent of the motor vehicle was accompanied by a strong clamor for better roads—better roads for the family car, better roads for the farmer to bring his products to market or to a rail head. The railroads were in the forefront of the early "good roads" movement, for they saw in good roads the answer to the problem of gathering and distributing the freight hauled by them in bulk volume between the larger populated centers. The movement gained public support and the old deep-rutted wagon trails

began giving way to improved roads capable of accommodating the more exacting needs of the rubber-tired motor vehicle.

As trucks and highways improved, public acceptance of motor transportation increased and trucks gradually took over the functions formerly performed by the horse and wagon; but as late as 1916 the railroads remained virtually unchallenged for volume movement of freight between centers of population. It was for this reason that just prior to World War I there were many who believed the trucking industry was approaching its peak and was destined to continue only as a local adjunct of railroad transportation. At that time, the nation boasted 200,000 trucks, most of them of the small delivery variety. But entry of the United States into the war in 1917 proved the springboard that started highway freight transportation on its way to becoming one of the leading industries in the country.

The vast movements of men and materials made necessary by the war placed an unprecedented strain on the existing transportation facilities of the railroads. The government assumed control of the railroads and encouraged use of motor trucks to supplement the rails wherever possible. Thus trucks were given an opportunity to roll out of the cities to the open road, a chance to test their speed, efficiency and economy on longer hauls.

The success of this experiment opened the eyes of shippers to the advantages of over-the-road truck service. Then, early in the 1920's, the growth of commercial vehicle transportation was stimulated greatly by adoption of pneumatic tires. Whether the pneumatic tire came into being as the result of plans for highway development or whether highway development followed the adoption of the pneumatic tire is impossible to determine. The two came together and each contributed to the other in pyramiding the potentialities of highway transportation.

First trucks to use high-pressure pneumatics in the early 1920's were the light duty types, while solid tires used on medium and heavy duty trucks still limited the latter to relatively slow speeds. By the end of the decade, however, even the heaviest-duty trucks were being equipped with high-pressure pneumatics, and as early as 1932 heavy-duty low-pressure pneumatics were being offered as standard equipment on medium and heavy-duty trucks.

These tires, with their ability to carry greater loads at sustained high truck speeds, now made it possible to carry freight by truck over long distances at high speeds and thereby compete effectively with railroads in long-distance hauling on the basis of operating efficiency and costs.

Truck registrations exceeded one million in 1920. By 1924, regis-

trations had exceeded the two million mark; by 1928, there were three million, and when the United States went to war in 1941 almost five million trucks, more than half of all the trucks in the world, were in operation on the streets and highways of the nation. At the close of 1948 there were more than seven million trucks registered in the United States.

It is fundamental that the motor truck has attained its present place in the transportation system of the United States because it has possessed certain inherent advantages over other modes of transportation.

Truck transportation is extremely flexible and convenient. Being a self-propelled vehicle on rubber-tired wheels, a truck is able to go wherever there is a road or highway, and even where none exists. Thus, trucks are able to serve economically many points and areas not served by other modes of transportation, since trucks have access to even the most remote places. In the United States there are 25,000 communities which have no railroad facilities. Most of them depend upon trucks for freight service.

Any point on any road is a point of origin or destination for the motor truck. Trucks pick up shipments right at the door of the shipper on short notice and deliver them directly to the door of the consignee. This results in less handling of the goods, faster delivery, and decreased cost. Since transfer of freight is held to an absolute minimum, packing and crating costs are greatly reduced or eliminated. In some instances, notably in movement of household goods, trucks do the entire job for less than it would cost for packing of goods for movement by rail. Reduced handling, as well as greater speed, curtails spoilage or damage of cargo.

Trucks excel in fast and cheap delivery of smaller shipments. This enables merchants to have fresh stock in the quantity they want and when they want it. Truck service also makes it possible for the merchant to reduce his inventory to fit his day-to-day requirements; he thereby cuts the costs of maintaining inventories and warehouses, maintains up-to-the-minute stock for his customers, avoids getting "stuck" with large quantities of out-dated items that will not sell, and increases inventory turnover with resulting increased profits.

Refrigerated motor trucks have revolutionized distribution of meats, fish, oysters and other perishable food products. Such products can be kept fresh and unspoiled while being transported hundreds of miles, and have been made available to countless small communities which once found it extremely difficult to obtain them.

Motor transportation is outstanding for its ability to adapt its service to the needs of the shipper. A wide range of sizes and types

of vehicles enables truck transport to fit a wide range of needs, both on and off the highways, which cannot be met by other modes of transportation. Trucks are built to carry almost any type of load and to operate under all kinds of conditions, and if there is no truck available to do a particularly unusual job an existing truck usually can be adjusted or rigged to meet the need. When the war stopped production of passenger cars, the approximately 8,000 trailers formerly used to transport automobiles from factory to dealer were adjusted to carry jeeps, ambulances, guns, lifeboats, airplanes, and other military equipment. Many were converted into buses to transport war workers. Some trucking companies specialize in unusual jobs and maintain trucks and equipment which make it possible for them to accomplish remarkable feats of transportation.

Truck service has resulted in a personal and cooperative relationship between those who own the freight and those who transport it. In the case of farmers and other private carriers who own their own trucks, the owner of the freight and the transporter of the freight have become the same. Thus, these private carriers have fast, flexible, and economical transportation at their beck and call at all times and they can transport their goods whenever and wherever they choose on a moment's notice. For those who do not have trucks of their own, a telephone call is all that is necessary to obtain the same kind of service from a for-hire trucking company. The average for-hire company is relatively small and its service is dedicated to relatively few shippers, most of whom are known personally by the owner of the trucking firm.

The natural speed of the motor truck on the highway, when combined with the more liberal packing requirements and the lack of need for transfer of freight, makes it possible for trucks to give service which in many instances is faster than the U. S. Mail. A phone call brings a truck to the shipper's door in a few minutes. The shipment is soon loaded and the truck is on its way. There is no waiting for accumulation of enough freight to make a carload and no sidetracking or reloading at points en route. Overnight service for distances of two to three hundred miles is common.

The natural economy of operating and maintaining truck equipment has combined with the other numerous advantages of motor transportation to make truck service outstanding from the standpoint of costs. Motor carriers have been able not only to perform cheap service themselves, but their competitive influence has resulted in lower rates by other transportation agencies.

Owners of motor trucks generally are divided into two major classes—private and for-hire. Private carriers are those who trans-

port their own property and do not serve others for compensation. Of the 7,200,000 trucks registered in 1948, about six million were engaged in private carriage, including the approximately 2,000,000 on farms. The remaining trucks, constituting about 15 per cent of the total, were engaged in for-hire service—operated by those who haul goods for others for compensation.

Of the total trucks registered in 1941, of all makes and capacities, it is estimated that there were concentrated in the service of 23,545 fleet operators (using eight or more trucks) a total of 1,018,734 vehicles.

Farmers and other operators of private trucks use them only as an adjunct to their regular occupation or business. They have found trucks valuable and desirable for hauling their own goods in varying phases of production or sale. Among the leading users of private trucks are bakers, bottlers and brewers, coal dealers, builders and contractors, dairies, department stores, feed and flour dealers, ice dealers, laundries, manufacturers, fish and meat dealers, newspapers, paint, chemical and drug interests, the petroleum industry, chain stores and public utilities.

The operating methods of private carriers are relatively simple and obvious. The private carrier simply acquires trucks of a size and type best fitted to his own particular needs and uses these trucks at his own convenience.

Operation of a for-hire trucking company is not nearly so simple. The for-hire operator must adapt his operations to the varying needs and desires of different shippers. Competition between for-hire motor carriers themselves, and between motor carriers and other transportation agencies is keen. Therefore, the cost of operation and the rates charged are of primary importance. It is natural, then, that for-hire truck operators, spurred by competitive necessity, have made the greatest strides in development of economical and efficient methods of operation. They are confronted continually with the problem of giving the shipper better and cheaper service than the shipper can obtain by operating his own trucks or by engaging services of other modes of transportation.

Registration figures fall far short of indicating the size and importance of the for-hire branch of the trucking industry. Although for-hire trucks constitute only about 15 per cent of all truck registrations, it is estimated that these trucks transport at least 50 per cent of all truck freight. This fact alone indicates the high degree of operating efficiency attained.

The for-hire branch of the trucking industry is divided into two major classes—contract carriers and common carriers.

The contract carrier, as the name implies, works under individual contracts with one or more shippers. His service is dedicated exclusively to those with whom he maintains a contract relationship, and to this extent at least the contract carrier is similar to the private carrier. For example, some contract carriers work exclusively for a large chain store system.

The common carrier, on the other hand, holds himself out to haul for anyone within the commodity and territorial limitations of his operating rights. He publishes rates which must be applied to all shippers alike without preference or discrimination. Some common carriers operate over regular routes and on regular schedules, and others operate over irregular routes within a specified area or territory.

The for-hire carrier has been a natural outgrowth of the early days when local drayage men used horses and wagons to haul goods for compensation, chiefly within cities or towns. A large segment of the for-hire branch of the industry even today is made up of local cartage operators whose trucks specialize in this type of work and never roll over the open road. These companies perform local pick-up and delivery service for over-the-road motor carriers, railroads and others. Many over-the-road truck operators, however, maintain their own trucks to perform their own local services.

Desirability and need of specialized transportation service has shaped the structure and methods of for-hire trucking just as it has affected so materially the technological development of the truck itself. The industry is made up of thousands of companies, each a specialist catering to a particular need. For example, most of the companies engaged in transporting automobiles do that and nothing else, and most of them are located in the Detroit manufacturing area.

Other specialists are carriers of household goods, petroleum products, liquid foods, oilfield equipment, chemicals, extremely valuable articles requiring armored guard service, boats, lumber, coal, livestock, clothing, extremely fragile articles, film, newspapers, perishables requiring refrigeration in transit, explosives, seafood and meat, airplanes, heavy machinery, and numerous other commodities requiring special types of equipment and handling.

The extent to which freight transportation on the highway enters into virtually every phase of the economic and social life of the United States is indicated by a breakdown of the country's more than 7 million trucks according to vocational uses. Such a breakdown is contained in the following table; and if the reader will glance over the figures he may more fully appreciate the vital role

truck transportation has assumed in the smooth and efficient day-to-day functioning of government, agriculture, industry and business, and the extent to which the existence of truck transportation directly or indirectly affects his own personal life. It is noteworthy, for example, that almost 2½ million trucks, or almost 35 per cent of the total, are used by farmers or farm groups in the production and marketing of agricultural commodities.

BREAKDOWN OF TRUCK FLEET BY VOCATIONAL USES

(Based on data compiled by the Office of Defense Transportation as of August 31, 1944)

	TRUCKS & TRUCK TRACTORS	PER CENT OF TOTAL	TRAILERS AND SEMI-TRAILERS	PER CENT OF TOTAL
Governmental agencies	353,520	4.91	11,280	3.76
Agricultural agencies	2,493,360	34.63	13,110	4.37
Extractive industries	142,560	1.98	14,550	4.85
Construction industries	658,800	9.15	11,220	3.74
Manufacturing industries	287,280	3.99	28,650	9.55
Wholesale distribution	553,680	7.69	21,180	7.06
Consumer distribution	1,023,840	14.22	14,880	4.96
Intercity common carriers	229,680	3.19	90,120	30.04
Local common carriers	178,560	2.48	15,210	5.07
All contract carriers	524,160	7.28	36,300	12.10
Other public utilities	133,920	1.86	16,560	5.52
Business, professional and personal services	196,560	2.73	5,700	1.90
Institutional agencies	30,960	0.43	510	0.17
Private tank trucks	138,240	1.92	10,290	3.43
For-hire tank trucks	21,600	0.30	10,230	3.41
Trucks for personal transportation	230,400	3.20	180	0.06
Not classified	2,880	0.04	30	0.01
TOTAL PROPERTY CARRYING VEHICLES	7,200,000	100.00	300,000	100.00

Now take another look at the total number of trucks in this country—7,200,000. That means that in the United States we have more motor trucks than all other countries of the world combined. It means that if this country's commercial trucks were lined up bumper to bumper they would stretch from Los Angeles eastward to Moscow, and across the broad expanse of European Russia into the wasteland of Siberia, a distance of more than eleven thousand miles. It means that we have become dependent, to an extent which few of us fully realize, upon highway freight transportation for virtually everything we eat, wear and use.

We need only to look around us, wherever we might be at the moment. How many articles do we see that have not moved by truck at one time or another, either in form of raw material or finished product? This simple test is proof enough that motor trucks and highways are not merely important in our national life, but have become absolutely indispensable.

24 MASS TRANSIT ON THE HIGHWAY

BY LESLIE WILLIAMS

HISTORY AND DEVELOPMENT

MASS transit—the provision of public conveyances for transporting people on highways as distinguished from private individual means of highway travel—early appeared in America. In the first decade of the 18th century a public wagon ran across New Jersey, while in 1732 the first long stage line began operating on a monthly schedule between New York City and Boston. Today, motor buses leave New York City and Boston approximately every hour on the hour and complete the trip in eight hours.

Urban mass transit began to take form about 1830 in New York City when 120 horse-drawn omnibuses gave a scheduled service, and in 1832 when the first rail streetcar began operation. Before this Americans either walked to where they wanted to go or had to provide their own means of transportation. American cities were small and compact in those days because the chief mode of travel was on foot.

Horse-drawn omnibuses were soon followed by horse-drawn rail cars. Then came the mechanically propelled cable car, and around 1890 the electric street railway became the dominant means of mass transit.

The electric street railway penetrated the boundaries of the compact towns of those days and was a major factor in producing the star-shape urban pattern with property developments lining the rail lines and clustering around rail transfer points. A great acceleration in the growth of urban population accompanied this advancement in transportation. Consequently, as people migrated to the city, others moved out along the streetcar lines. New industries and commercial establishments followed, increasing land values and making new developments and redevelopments profitable. Street traffic congestion increased during this period of urbanization, and it became profitable to move people on elevated structures and in subways.

Electric street railways prospered in this era and reached their heyday following World War I. The year 1917 marked the maximum number of streetcars (72,911), while 1923 marked the maximum riding on streetcars. Thereafter street railways began to decline,

only to be supplemented, duplicated, and replaced by motor buses rolling on *pneumatic* tires over paved roads, aided and abetted in their expansion by the private automobile and single-family house building in the suburbs. At the end of 1948, there were only 17,911 streetcars left, and soon the clang-clang-clang of the trolley will be heard no more.

The star-shape urban pattern set by electric railways was disrupted by the automotive industry and transformed into an amorphous mass, perceptible in the early 1930's. Much suburban land was brought into competition with city land. Population began to level off about this time; consequently, the rate of influx of people into the central areas was not as fast as before. In-town, high-valued land could not compete with cheaper suburban land. The result was that the older areas, partly commercial, partly industrial, and partly residential, became partially vacant, blighted and are now in sad need of rehabilitation and reconversion.

The motor bus started in this country with elongated automobiles and grew with hard-surfaced roads. Buses helped fill in the interstices between electric rail lines and expand the potential area of urban development. Buses permitted a gradual decentralization of population.

Before the end of the 20th century, intercity, suburban and city buses, operating over the proposed 40,000 miles of the Interstate Highway System and its tributary major routes, might well bring forth a new metropolitan pattern, consisting of a central city in a group of suburban communities and planned neighborhoods, and surrounded by self-contained satellite towns, all planned around the major focal or transfer points on the National highway network. In other words, 20th century rubber will replace 19th century rails as the determinant of the future pattern of our cities.

It appears that central areas will continue to lose population to the suburbs. Newcomers will settle in the outskirts and work in and near the centers. *Express* transit service and crosstown routing will constitute a greater proportion of local transit mileage in the future. Despite this, local street transit riding will decline and level off between two-thirds and three-fourths of the 1946 all-time high in transit riding of 20,437,000,000 passenger rides; but passenger mileage generated by public transit will, in general, remain high due to increases in intercity operations and in the increased average length of local and suburban transit rides.

CLASSES OF TRANSIT

Approximately 190,000 mass transit vehicles—motor buses, trolley coaches, and electric street railway cars—conducted their business of providing rides on public streets and highways in the United States in the all-time riding year of 1946.

TRANSIT VEHICLES IN 1946

CLASSES	MOTOR BUSES	TROLLEY COACHES	STREET-CARS	TOTAL
Intercity	26,000	—	—	26,000
Charter-Contract	1,475	—	—	1,475
School	81,200	—	—	81,200
Urban	52,450	3,896	24,730	80,076
TOTAL	161,125	3,896	24,730	188,751

Intercity. Intercity service may be classified by fares into long-haul (35¢ and up) and short-haul (15¢-35¢). Intercity motor buses cover all the primary roads on the State Highway Systems and bring the use of modern transportation to rural and city folk alike.

In 1946 intercity buses traveled over two billion vehicle miles carrying nearly a billion passengers. In less than a quarter of a century intercity motor buses have become a primary intercity carrier, surpassing the passenger levels of Class I railroads. During World War I the railroads carried the intercity passenger load, but in the first year of World War II intercity buses assumed more than half of all the intercity passenger travel.

With liberalization of interstate travel restrictions, uniformity in state regulations of vehicles, equal treatment on the highway with the private automobile, modernized equipment and sound merchandising practices, intercity mass transit will become an even more important part of America's transportation system.

Charter-Contract. Charter hire generally follows no fixed route and also operates a sightseeing business. During the war these were engaged mostly in service to war plants and military establishments.

In 1946 charter service resumed its contract operations along with sightseeing operations. In that year approximately 800 companies did a $10 million business, transporting more than 20 million people in 1475 motor buses.

School Service. School bus operation in the United States runs above $100 million a year. In 1946, schools used 81,200 buses and carried almost 5,000,000 children daily, operating over 2,000,000

miles of highways and generating a half billion bus miles and more than one and a half billion student rides.

This is not the whole story of student transportation because it does not include the service operated by common carriers on regularly scheduled transit vehicles, or transportation to and from school in passenger cars and other conveyances.

School bus transportation expanded when the "little red school house" gave way to the consolidated school. School officials visualize a new era in school bus design. Geographical factors preclude complete standardization of vehicle design; but national uniformity of body color, safety devices, and operation regulations are fast becoming a reality.

LOCAL STREET TRANSIT

Local street transit, herein discussed, covers all organized passenger transport facilities operating on the surface of public streets, but excludes taxicabs, charter, sightseeing and school buses, suburban railroads, and rapid transit elevated above and subway systems below public streets. Local street transit is the operation of motor buses, trolley coaches, and streetcars over prescribed streets, on predetermined schedules, for the purpose of providing rides at an agreed fare between designated stops.

Local transit is an essential means of transportation. It provides en masse for the needs of those who cannot afford or do not desire to provide their own individual means of transport at all times.

It is a public utility, having very definite responsibilities to the community, which are set forth in franchises, permits, and regulations aimed at encouraging efficiency and economy in serving the public.

Part of the City Plan. Street transit has a close relation to community development and is taken into account in all plans for the location and character of streets and other public ways and transportation facilities, parks and amusement places, community centers and neighborhood units, redevelopment of slums and blighted areas, regulations governing the use of private and public lands and structures, and the density of population. It is also frequently involved in other recommendations in the master plan for the physical development of a community.

Street transit is a mighty mover of people in cities. Over 15 billion one-way journeys and over 20 billion passenger rides, if transfers and free rides are added, were taken by persons on local transit vehicles in 1946. Prior to World War II and its inflated riding, 1926 marked the previous record in local street transit riding.

STREET TRANSIT REVENUE PASSENGERS
(millions)

YEAR	STREETCARS	TROLLEY COACHES	MOTOR BUSES	TOTAL
1926	9,744.7	–	1,777.1	11,521.8
1936	5,276.0	122.6	2,773.7	8,172.3
1946	6,503.0	1,050.0	7,556.0	15,109.0

The revenue passengers transported in 1946 were distributed by type of vehicle and population groups as follows:

REVENUE PASSENGERS CARRIED ON LOCAL STREETS IN THE U. S. IN 1946 BY POPULATION GROUPS AND TYPES OF VEHICLE

POPULATION GROUP	STREET-CAR (millions)	TROLLEY COACH (millions)	MOTOR BUS (millions)	TOTAL (millions)
Over 1,000,000	2,855	63	1,707	4,625
500,000-1,000,000	1,752	144	652	2,548
250,000- 500,000	898	425	1,468	2,790
100,000- 250,000	451	223	1,638	2,312
50,000- 100,000	366	114	1,402	1,882
Less than 50,000	181	82	689	952
TOTAL	6,503	1,051	7,556	15,109

Motor bus passengers constituted more than half the 1946 street transit riding and were fairly evenly distributed in each population group with two-thirds of the riding in cities of 100,000 population and over.

One-half of the trolley coach riding was in cities from 250,000 to 500,000 population. Two-thirds of the streetcar riding was confined to cities of 500,000 population and over.

Local transit riding has decided seasonal fluctuations. December is the high month of the year closely followed by March and then October. The low point comes around July or August.

Local street transit becomes more important as the population of the city increases. Passenger riding ranges from one ride a day for every five persons in small communities to almost a ride a day for each person living in cities over one million population.

Local transit is of particular significance to highly concentrated central business districts. Practically all local transit lines lead to the city center and form the hub of the transit system.

During the past twenty years cordon counts have been taken of the mode of travel by persons entering and leaving business districts in cities of all sizes. It is difficult to generalize from these counts due to the many variants involved such as:

Tributary area
Population served and distribution trends
Size and character of the downtown area
Presence of rapid transit rail service
Street layout and design
Status of urban area in terms of growth
Level of employment at time of the count
Season in which the cordon was made
Standard of transit service and other factors

Nevertheless, these counts do indicate that in planning a city's transportation and traffic needs the following will be useful:

In small cities four out of every five persons riding to the central business district come in their own private automobiles.

In medium size cities two out of every three persons riding to the central area come in their own private automobiles.

In large cities (over 500,000 population):

Without rapid transit: two out of every three persons riding to the central area come by public transit.

With rapid transit: four out of five persons come to the central area by public transit.

In New York City about nine out of every ten persons entering Manhattan daily do so by public transit.

From the public point of view local transit is primarily a home-to-work means of travel in urban areas, especially in large and medium size communities.

It is during the morning and evening rush periods that public transit assumes its greatest importance to the community.

The following table shows the relative numbers of people carried from central business districts of four cities during the evening rush.

PEOPLE CARRIED FROM CENTRAL BUSINESS DISTRICTS

			Vehicles		*Passengers*	
CITY	YEAR	TIME	TRANSIT	AUTOS	TRANSIT	AUTOS
Atlanta	1945	5-6 P.M.	446	11,035	24,517	20,100
Dallas	1945	4:45-5:45 P.M.	442	19,913	23,253	21,664
Kan. City, Mo.	1946	5-6 P.M.	583	10,093	28,245	19,478
Memphis	1946	5-5:30 P.M.	222	5,291	10,910	9,874

If the estimated 18,000,000 people carried in motor buses, trolley coaches, and streetcars during the average evening rush period in 1946 had resorted to private automobiles to get home, an additional 10,000,000 private automobiles would have been needed. It is most unlikely that all the persons carried in the peak hours in transit vehicles will turn to private automobiles. Many will, but transit will remain the major passenger-carrier in the peak periods in our large cities.

Important User of Streets and Highways. City administrators are constantly confronted with the problem of getting maximum use out of existing street space. This is a very difficult problem in view of the following facts: City streets are relatively permanent in width and alignment; vehicular traffic volumes are constantly increasing; downtown expressways and by-passes are expensive; and off-street terminals for private automobiles, trucks, and buses lag behind the demand.

It is only natural that attention has been directed to street-space relationships of private automobiles and transit vehicles in congested areas.

The streetcar, despite its greater carrying capacity, is being replaced by the more maneuverable and flexible bus. Rigid rail vehicles were excluded from the center of London many years ago and today no streetcars operate over the streets of Manhattan, New York City.

Hawley S. Simpson, in a study of the relative vehicle and passenger capacity of surface streets, indicated that a lane of 40-passenger buses inserted in a traffic stream (3 street lanes in one direction—generating 2,115 private automobiles) would reduce the vehicular capacity of the three lanes to 1,215 private automobiles and 180 buses; but that the passenger carrying capacity of this three lane stream could be increased from 3,700 people to 11,130 passengers per hour with the buses operated with all seats occupied and a standing load of 25% of those seated.

Dr. Bruce D. Greenshields, in a study of time-space relationships of traffic in urban areas, found that if buses are in a traffic lane, their extra length is the only feature that differentiates them from passenger cars, because the average clearance was found to be the same.

A traffic count made in the center of Hartford, Conn., by the City Department of Engineering, showed that motor buses were many times more efficient as passenger carriers in the rush period than private automobiles. Sixty-four motor buses, carrying 3,085 passengers, passed northbound on Main Street at Talcott Street on May

23, 1947, between 4:30 P.M. and 5:30 P.M., while 742 private automobiles carried 1,438 persons past the same point in an adjacent traffic lane.

A transit study completed in Newark, N. J., in September 1946 showed that during the morning and evening rush hours, the following maximum number of buses and trolley coaches are in operation on the four principal downtown streets:

Broad Street (Branford Place–Raymond Blvd.)	733
Washington St. (Raymond Blvd. North)	491
Raymond Blvd. (Broad St. South)	329
Market St. (Washington–Broad)	280
Park Place	217

The report states: "Theoretically, the vehicles operate on a headway of less than ten seconds northbound during the morning rush. Obviously, because of parking and lack of sufficient curb space, it is impossible for more than a few buses to discharge passengers at the curb and it is not uncommon for buses and trolley coaches to be lined up three abreast. This is a dangerous situation and should be remedied. Approximately 50% of the buses operating on Broad Street at the present time have seating capacities of 30 passengers or less."

With the coming of urban expressways and the demand for more express transit service between in-town employment areas and outlying residential areas, careful attention is being given to the location and design of bus turnouts and transfer stations within expressway rights of way and their effect upon vehicular movement on the expressway.

O. K. Normann, in his studies of traffic lane capacity, states that "In urban areas the maximum working capacity for a multi-lane expressway is 1,500 passenger cars per hour for each lane in the direction of heavier travel . . . the average speed for all vehicles will be between 30-35 miles per hour. The Lake Shore or Outer Drive in Chicago with its 8 lanes is one of the most efficient facilities. . . . On multi-lane facilities with uninterrupted flow, one commercial vehicle has approximately the effect of two passenger cars in level terrain."

In a traffic check on the Outer Drive in Chicago, it was found that in the peak hour the maximum passenger car lane served 3,026 people, while an adjacent lane carried 7,012 persons in motor buses plus an additional number of persons in private automobiles.

Experts estimate that a parkway, built to standards set forth in the Interregional Highway Report, costs approximately $500 per mile per passenger when used only by private automobiles; but if

bus turnout facilities are incorporated and the parkway is operated as an express highway, the cost per passenger per mile drops to $250.

Buses are safe users of street space. According to National Safety Council figures, from 1941 to 1943 there were on the average 3.2 deaths per hundred million passenger miles in automobiles and taxis, whereas during the same period and the same mileage, only 0.2 deaths ocurred to those riding in motor buses.

In 1946 in Hartford, Conn., 38 persons were injured in accidents involving motor buses, while 971 persons were injured and 9 killed by other motor vehicles.

The approximate 190,000 transit vehicles in operation in 1946 traversed over 2 million miles of roads and streets.

MILES OF STREETS AND HIGHWAYS TRAVERSED—1946

CLASSES	MOTOR BUSES	TROLLEY COACHES	STREET-CARS	TOTAL
Intercity	350,000	—	—	350,000
Charter-Contract	no data	—	—	—
School	1,915,000	—	—	1,915,000
Urban	39,800	1,200	8,230	49,230
TOTAL	2,304,800	1,200	8,230	2,314,230

It is estimated that local transit vehicles generated about 3 billion miles on approximately 50,000 miles, or 20% of the total street mileage of American cities and traversed about one-half the mileage of paved streets in cities.

ROUTES

Modern street transit requires hard-surfaced roadways, well constructed and kept in good repair and reasonably free from snow, ice, and skid tendencies.

These roadways must be well designed with sufficient number of lanes of adequate width and adequate radii at turns to accommodate vehicles that are 8 feet wide and more than 35 feet in length, with a turning radius of 45 to 50 feet.

Loading zones at the curb for motor buses and trolley coaches and well-protected passenger streetcar waiting zones must be carefully located.

In some cities, as in Boston, streetcars are confined to a mall in the middle of wide avenues. In Oakland, California, rapid transit trains still operated on the streets in the business district in 1949.

Today, it is the street pattern which dictates the layout of transit lines, but prior to 1920 the street pattern was the outgrowth of

a combination of factors, chief of which were real estate land development, geographical features, and streetcar extensions. Consequently, most street patterns are irregular, incomplete, and in need of comprehensive planning.

The transit route layout invariably stems from the business center and shoots out along the inarticulated gridiron and checkerboard streets, some with and some without superimposed radials and diagonals, in a most confusing diagram, with no apparent consideration for crosstown or circumferential routing.

The future will see a number of changes in transit routes as expressways and by-passes are constructed and major street improvements made. This will be done to achieve greater coverage of the urban area and provide more direct routing and conformance to the major travel lines desired by the people.

Careful studies of transit routes are being carried out by planning and traffic officials which will result in a systematic procedure for transit routing and a closer relationship to present and future population distribution, land and property developments, and travel requirements of urban population.

SERVICE

In considering local transit service, two questions arise—what type of service should be rendered and how much?

Several types of service are rendered today in addition to the regular, frequent-stop, local service, such as express, shoppers', specials, shuttle from perimeter parking lots, charter, sightseeing, and airport; and some transport companies operate taxicab service.

How much service is a problem of scheduling or splitting and allotting time. "Time is constantly growing in value," said F. W. Doolittle in his treatise, "Cost of Urban Transportation Service," published in 1915. More than thirty years have elapsed since Mr. Doolittle wrote those half dozen words, yet we cannot travel across our business districts any faster today than our fathers could in their day.

The importance of travel time is evidenced by college training in traffic engineering and enforcement, in city planning and highway development to expedite street traffic.

The traffic engineer is a time splitter, especially when he concerns himself with traffic signals or reduces travel delays by other traffic control measures.

Transit is in the business of selling time, not clock-elapsed time, but mental-elapsed time, i.e., the pleasure or pain created in the mind of the rider of a transit vehicle from origin to destination.

The shorter the mental-elapsed time, the greater the pleasure to the passenger and the greater the number of transit patrons.

The transit schedule maker must consider travel characteristics and fluctuations between home and work travel, movements to and from schools, stores and amusement places.

He must provide headways with a satisfactory standard of service. It is important that there be schedule adherence, regularity, and coordination with other route schedules at transfer points.

An occasional ride on a line with notations recorded on "the back of an envelope" is outmoded today. Only by regular and systematic recording of origin and destination, on and off movements, traffic volumes and delays and other traffic data can transit men keep abreast of the service demands of the public.

VEHICLES

Modern travelers require not only convenient routes and schedules but also up-to-date vehicles. Modern conditions require maneuverable and flexible vehicles.

Population in the future will be more liquid and mobile. New areas will be constantly developing and vehicles of varying sizes will be necessary to meet the demands of the fluid city of the future. Automobiles and trucks are increasing and transit vehicles must be capable of by-passing traffic "bottlenecks."

New developments requiring a shifting of service throughout different hours of the day will require the utmost flexibility in equipment.

A recent American Transit Association study offers the following example of the relative investment required per maximum scheduled vehicle, taken from a single route.

Investment Per Maximum Scheduled Vehicle

TYPE OF VEHICLE	VEHICLE AND 10% SPARE ONLY	ADJUNCT FACILITIES	TOTAL
Streetcar (old type)	\$12,000	\$59,500	\$71,500
Modern Streetcar	27,500	59,500	87,000
Modern Trolley Coach	19,800	12,100	31,900
Modern Motor Bus	16,500	4,200	20,700

The caution of investors has forged initial cost of new vehicles to the forefront. The vehicle is an important element in the level of transit riding. Studies show that riding increases from 10% to 15% when new and suitable vehicles are placed in operation.

Public preference, passenger-appeal life of the vehicle, initial

investment, service demands, traffic conditions, operation and maintenance costs, are all interwoven with wages, taxes, existing obligations, and other considerations in vehicle selection.

The need for careful and comprehensive scientific analysis and interpretation of transit routing, scheduling and vehicle selection is evident.

As of December 1948, the number of local street transit vehicles in operation was 82,159.

TRENDS IN STREET TRANSIT VEHICLES BY TYPES
1917-1948

AS OF DEC. 31	STREET-CARS	TROLLEY COACHES	MOTOR BUSES	TOTAL
1917	72,911	–	–	72,911
1928	58,940	41	19,700	78,681
1938	31,400	2,032	28,500	61,932
1948	17,911	5,708	58,540	82,159

A significant feature in the trend of types of vehicles is the rise of buses and the decline of streetcars. Streetcars on rails are giving way to rubber-borne vehicles; and in not many years electric railways will be confined to separate rights of way and not be part of the regular traffic stream of a public street.

We are witnessing a cycle from freewheel horse omnibus to freewheel motor bus being completed in mass transit on the highway in a little more than a century.

ORGANIZATION

To function properly transit requires an organization.

With the trend from private to public operation, frequent mention is made of a transit authority to establish and operate a unified system of transit facilities for transportation of passengers throughout a metropolitan area.

Local public transit is definitely part of the metropolitan traffic system and requires unification of all the transit lines and coordination of transit with plans and projects of other agencies dealing with traffic, transportation, and the physical planning of the service area.

ECONOMICS

The economics of public transit are part of the economics of the city. Urban population changes, business and industrial activity, levels of employment, fares, standard of service, volume and use of private automobiles, management foresight, these and a number of other factors determine the level of transit riding.

Local transit has real economic significance in our cities. Over $2 billion was invested in local street transit facilities in 1946. Local street transit collected over $1 billion from over 15 billion revenue riders or an average of about 8¢ for each revenue ride or 6¢ for a single ride excluding the cost of the transfer.

With a $1.5 billion investment, streetcars took in less than $0.5 billion; while motor buses with about $0.5 billion investment, took in about $0.5 billion in revenue.

A dollar paid into local transit in 1946, was divided as follows:

Payroll	49.43¢
Materials	12.89
Taxes	10.06
Expenses and Claims	9.02
Depreciation	8.31
Interest and Rentals	6.62
Dividends and Surplus	3.67

A readjustment is taking place in the division of the transit revenue dollar which poses major policy decisions for communities, counties, states, and the Federal government regarding the movement of people within urban areas, especially in peak periods when moving people in mass carriers is most efficient.

The greater the percentage of people who are carried in the rush hours by transit vehicles, the smaller is the problem of street traffic congestion, but to persuade car owners to leave their autos at home and use transit, calls for more than subsidizing transit. It also involves convenience, comfort, congestion—to say little of the problem of changing human nature; and this is most difficult because we live in the American kingdom of the automobile.

Mass transit on streets and highways is of major public concern; and in large cities is vitally involved in the solution of street traffic congestion, accidents, and other city planning problems, which have reached alarming economic significance.

Transit is related to our religious, cultural, social, and economic life and was a big factor in the last war, conserving transportation materials and manpower.

A great transit leader now dead, Charles Gordon, expressed the key to the future of transit in one word—COORDINATION—coordination of transit, highway, and city planning.

25 THE HIGHWAY AND LAND USE

BY DAVID R. LEVIN

FOR many years past, highway authorities have sought ways and means to promote highway safety and efficiency of movement by motor vehicle. Progress toward the attainment of these objectives has resulted from the provision of more adequate rights of way, improvements in alignment and sight-distances, the betterments in road surfaces and gradients, the divided highway, the utilization of many types of traffic and safety devices, and from numerous other techniques. As a result, public roads today are better than ever before.[1]

Yet the efforts of highway administrators have not been wholly successful. A measure of their failure may be found in the human and economic toll of motor vehicle accidents, the ugly congestion, delays, high operating costs, and the lack of accommodations which harass the movement of urban and some rural traffic.

Alert to these inadequacies, highway engineers are constantly improving highway design and construction technique. They are becoming increasingly aware of the need for reasonable public control of the use of lands adjacent to the modern arterial highway, however much they may dislike the imposition of restraints (see Figure 1). It is the purpose of this commentary to examine and appraise the more important devices that may be utilized to control the relationship of the road to its adjacent land-use environment.

HIGHWAY SYSTEMS AND ROAD FUNCTIONS

Basically, a road is but a contrivance for facilitating travel from one point of the earth's surface to another. As the road developed from merely a narrow primitive route of blazed trees marking the way, to a broad surfaced highway of modern design, its functions have become many and diverse. Some insight into the complexities of present highway systems and their functions is revealed in Table 1.

Before the era of motor transportation, practically all highways

[1] Salutary progress has likewise been made with respect to the quality of the motor vehicle itself and the ability of its driver as well. The excellence of automotive design and manufacture is a matter of common knowledge. Driver safety and traffic programs have done much to diminish the destructive effects of misuse of the motor vehicle.

and streets were utilized largely for direct access to farms and homes, factories and business establishments, and recreation facilities. This is the concept of the "land service" road. The fact that a few of the more important routes of travel incidentally also accommodated a very limited volume of "through" traffic created no special hazards or excessive inefficiencies of travel.

However, with many millions of motor vehicles annually generating many billions of miles of travel today, the functional utilization of a given road system for different types of traffic has become a serious menace to safety and efficiency of motor travel. The "land service" function of providing direct access frequently works at cross purposes with the through-traffic function of facilitating the safe movement of large numbers of vehicles with a minimum of obstructions and a maximum of speed. The result is congestion, traffic accidents and high costs of operation.

TABLE 1. FUNCTIONAL UTILIZATION OF URBAN AND RURAL STREET AND HIGHWAY SYSTEMS

SYSTEM	SCOPE
Urban	
Primary street system	The network of main traffic arteries furnishing interconnection between the major sections of a city.
Secondary street system	The web of minor traffic channels—the sub-arterials—which distribute traffic within a given urban district, and serve as routes intermediate between the primary street system and local streets.
Local street system	Streets, the principal function of which is to provide direct access to adjacent residences, business establishments, recreational facilities, and the like.
Rural	
Primary State highway system	The network of major State traffic routes comprising the State-designated system.
Secondary highway system	The web of traffic channels distributing traffic between the State primary system and land service roads.
Land service road system	Roads, the principal function of which is to provide direct access to farms and rural homes.

Accordingly, highway planners today are endeavoring, wherever feasible, to design urban streets and rural highways with due regard for the dominant functions such roads are to perform, while

at the same time making adequate provision for the subordinate uses.

CONTROLLED ACCESS HIGHWAYS

A technique of promising potential for the public regulation of the highway and of its adjacent land uses is the controlled-access highway. The controlled-access facility seeks to minimize obstacles to the free flow of through traffic by the provision of points of entry to and exit from the facility at designated locations consistent with safety and efficiency. Frontage roads or local ways are often provided to serve adjacent property, and access may invariably be had to and from the general pattern of highways and streets in the vicinity. As types of controlled-access highways, the freeway serves all customary forms of street and highway motor traffic, while the parkway is restricted to passenger vehicles only.

Controlled-access highways are now sanctioned by legislative action in 30 states,[2] by constitutional provision in 1 state, and by judicial decision in an additional state, Minnesota. At a special election late in February 1945, the Missouri electorate approved a revised Constitution; Article IV, section 29, among other things provides that the highway commission shall have authority "... to limit access to, from and across State highways where the public interest and safety may require, subject to such limitations and conditions as may be imposed by law." This is the first instance of legal sanction of control of highway access by organic law. Several states, Oregon and Wisconsin, for example, permit the acquisition of "access rights." In other states, and prior to recent enactments, controlled accessibility has been attained by the use of ingenious legal techniques.[3]

Over a thousand miles of controlled-access highways and streets are to be found in at least 17 different states. Over double this mileage of arterials in 25 states has been initiated by the states and approved by the Public Roads Administration as eligible for Federal and state advance planning funds.

Outstanding examples of this type of highway in California are the Arroyo Seco Freeway between Pasadena and Los Angeles, the

[2] California, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New Mexico, New York, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Texas, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming.

[3] See "Public Control of Highway Access and Roadside Development," Public Roads Administration (revised, Washington, 1947).

PUBLIC ROADS ADMINISTRATION

DOUBLE-DECK BUS ON OUTER LAKE SHORE DRIVE, CHICAGO

This picture shows the automatic dividers separating the incoming from outgoing traffic. These dividers are raised at different times in the day to accommodate the uneven flow of traffic.

N.Y. DAILY NEWS

END OF AN ERA

A documentary picture taken on June 29, 1947, when the last streetcars were discontinued in Manhattan. This event concluded a cycle in mass transit—from freewheel to freewheel in a little over a century.

Cahuenga Pass Freeway between Hollywood and the San Fernando Valley, and the Ramona Freeway in Los Angeles. Connecticut roads of advanced design are the Merritt Parkway, the Wilbur Cross and Milford Parkways, and the Hartford Bypass. Chicago's excellent Outer Drive on the shores of Lake Michigan is a model development. More recent improvements include the new Davison Limited Highway and the Detroit Expressway System in Detroit and its metropolitan area, and the Willow Run Expressway System in the same vicinity.

Missouri has its Oakland Express Highway and Ohio its Lakefront Freeway. Sections of the Shirley Memorial Highway, Lee Boulevard, the Pentagon Building road network, and the Mount Vernon Memorial Highway in Virginia are likewise of controlled-access design. The Pennsylvania Turnpike is one of the best-known facilities of modern design.

The unique parkway system in and around New York City has effectively demonstrated the usefulness of this type of road. It includes the Gowanus Elevated Highway, the Belt, Whitestone, Grand Central, Interborough, Northern State, and Southern State Parkways, and others on Long Island; the East Side Drive, the West Side Improvement, the West Side Elevated, the Henry Hudson, Bronx River, Bronx-Pelham, and Hutchinson River Extension Parkways in Manhattan and the Bronx. The Westchester County parkway system includes the Saw Mill River, the Cross County, the Bronx River, and other parkways.

Florida has its Overseas Highway, and the Skyline Drive in Virginia is known to millions of motorists. The interstate national parkways include the Blue Ridge, the Great Smokies National, and the Natchez Trace Parkways.

Comparisons of these routes with roads of ordinary design reveal conclusively that the controlled-access facility is far superior wherever large traffic flow is to be accommodated. The cost of these super-facilities is high to be sure, but they are certainly economic in terms of human and material resources preserved, hazards eliminated, time saved, and in the promotion of orderly development. The controlled-access device insulates the road from its environment, and at the same time liberates the environment from the road. Both profit.

The fact is frequently obscured that express highway improvement with its sometimes incidental park and playground developments in many urban areas has indirectly resulted in the elimination of substandard and slum areas. At the same time, such activities have in some instances provided the incentive for further redevelop-

ment of obsolete and undesirable city areas. New York City provides a striking illustration.

MARGINAL LAND ACQUISITION

A device sometimes more effective than the acquisition of designated easements in the highway roadsides is the outright acquisition by public authorities of lands marginal to the highway. By purchasing the margins of selected main highway routes at the time such improvements are first established, roadside development and access may be controlled in the public interest, and highway facilities effectively insulated from detrimental adjacent growth. Through a farsighted right of way policy, adequate provision can be made at moderate cost for future highway development, thus forestalling prohibitive costs later.

Marginal land acquisition as an instrument of public control of the roadsides is sanctioned by constitutional amendment in only eleven states,[4] though a number of other jurisdictions have enacted statutes authorizing the device with varying restrictions.[5] The judiciary has yet to give it unqualified endorsement. To date, the practice has had only limited application. Where applicable, marginal land acquisition can prove to be highly advantageous.

LAND-USE CONTROLS

Both highway access control and marginal land acquisition, dealt with in the foregoing sections, presume the purchase or condemnation, for a just compensation, of designated property rights. There is, however, a species of regulation of private property that involves neither the acquisition of rights or compensation, namely, land-use controls.

Highway land-use control is the regulation by the state or its subdivisions of the uses of private property along the margins of public roads. It may consist of zoning, platting and subdivision control, and billboard and set-back regulation.

Though this technique is now customary in the development of most urbanized land areas in the United States, its application to the margins of roads and streets is still in its formative stages. There are many who believe that most types of land-use control can never constitute a permanent and effective solution to the ribbon-development problem because that type of regulation stems from the state

[4] California, Massachusetts, Michigan, Missouri, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Virginia, and Wisconsin.

[5] See "Public Control of Highway Access and Roadside Development," Public Roads Administration (Revised, Washington, 1947), 59 et seq.

police power. The courts have ruled that when the exercise of the police power is so arbitrary and unreasonable that the interference is in substance a taking of private property rather than a mere regulation of its use, it can be justified only as an exercise of eminent domain and therefore must be accompanied by express or implied provision for just compensation.

Despite shortcomings, highway land-use controls, revised and enlarged, can become a valuable auxiliary device in regulating land uses detrimental to modern highways. Properly conceived, such regulation appears to be flexible enough to meet the demands of a dynamic society which is characterized by the concentration of population into relatively small areas and by an ever increasing variety of business and industrial processes.

HIGHWAY DEVELOPMENT RIGHTS

The National Interregional Highway Committee and the Public Roads Administration have recently proposed the control of a portion of highway margins through the acquisition of highway development rights. This would necessitate the appropriation by the state or its subdivisions of the right of private property owners to improve road margins. The immediate effect of the device would be to arrest all roadside development detrimental to or inconsistent with the function and future expansion of the highway. Broadly conceived, this concept provides for the acquisition of a private owner's right to convert agricultural or other undeveloped land to residential, commercial, or industrial uses.

Owners abutting roads where highway development rights have been acquired would exercise all the privileges of ownership in road margins of 100 or 200 feet depths, as the case may be, except the right of development. That is, they would be divested of the right to use such strips in any manner inconsistent with the purposes for which the highway was designed. In terms of existing concepts, this probably would amount to the creation of a new marketable interest in property, and its valuation and acquisition by the state.

The pilot application of this new idea took place recently in Ohio on a four-mile section of the Columbus-Wooster Road in Delaware County, State Highway 24, Section S on new location. This section of road is part of a planned Cincinnati-Cleveland express highway, a portion of which, at least, will be designed with access controlled. Ohio authorities indicate that from past experience Delaware County is one of the most difficult counties in which to obtain right of way.

Twenty-two parcels of land are involved in this section of road, and highway-reservation agreements were executed by the owners of 21 parcels. The single recalcitrant owner apparently has no objection to the reservation of a portion of his land for future highway use or to the amount of compensation offered therefor, but desires access to the highway where no such access is permitted by its expressway design.

The compensation paid for these reserved areas is uniformly at the rate of $5.00 per acre or portion thereof. An amount of $421 was paid for 21 reservation agreements covering 3.85 miles of road, or at the rate of $109.35 per mile, an amazingly low price for the type of protection granted. Ohio highway authorities estimate that the average state investment will range from $60 to $120 per mile, depending upon the width of right of way and the area protected.

APPLICATION OF PUBLIC CONTROLS TO ROAD SYSTEMS

These, then, are the major instruments for the public control of the uses of lands adjacent to streets and highways. Because each of these major devices possesses individual inherent advantages, not necessarily common to them all, an instrument should be applied to the type of highway facility to which it is best adapted. In Table 2 there is recommended a specific application of each of the public control devices to the various urban and rural street and highway systems. Minor regulatory instruments such as deed restrictions, voluntary set-back agreements, and the like, are deemed to be of little practical significance.

TABLE 2. RECOMMENDED APPLICATION OF MAJOR PUBLIC CONTROL DEVICES TO URBAN AND RURAL STREET AND HIGHWAY SYSTEMS

TYPE OF FACILITY	APPLICATION OF PUBLIC CONTROL DEVICE
Urban	
Primary street system	(a) Controlled-access highways (parkways and freeways) for all new through routes; conversion of as many existing through routes to controlled-access ways as is financially feasible.
	(b) Marginal land acquisition where economic.
	(c) Land use controls and acquisition of street development rights, particularly where facility is not of controlled access.
	(d) Liberal initial right of way acquisition policy.

TYPE OF FACILITY	APPLICATION OF PUBLIC CONTROL DEVICE
Secondary street system	(a) Effective application of land-use controls and acquisition of street development rights. (b) Marginal land acquisition as an auxiliary device where economic. (c) Controlled-access facilities where traffic warrants it. (d) Liberal initial right of way acquisition policy.
Local service streets	(a) Effective application of land-use controls. (b) Marginal land acquisition as auxiliary device where economic.
Rural	
Primary state highway system	(a) Controlled-access highways for all new routes and conversion of existing routes to controlled-access ways, where traffic justifies it and where financially feasible. (b) Marginal land acquisition as an auxiliary device where economic. (c) Effective application of land-use controls and acquisition of highway development rights, especially where facility is not of controlled access. (d) Liberal initial right of way acquisition policy.
Secondary highway system	(a) Effective application of land-use controls and acquisition of highway development rights where traffic warrants same. (b) Limited application of marginal land acquisition as auxiliary device where economic. (c) Controlled-access highways in isolated instances where traffic warrants it and where financially feasible. (d) Liberal initial right of way acquisition policy.
Land service road system	(a) Limited application of marginal land acquisition as auxiliary device where economic.

CONCLUSION

Several decades ago it was true that a road was a good road if it had a bituminous or concrete surface. Today, highways must be safe, convenient and efficient. The road surface is but one of many factors affecting these elements.

Recent investigation discloses that highway transportation service can be improved immeasurably by reasonable public control of highway access and of the uses of lands adjacent to main roads.

If such controls are boldly, yet realistically, sanctioned and applied, a good highway system can be improved to become a much better one. Inaction or ineffective implementation will mean that extensive portions of that system will be doomed to early functional obsolescence, and that millions of dollars of public funds will be spent unwisely.

26 THE HIGHWAY AND THE DIVIDED CONSTITUTIONAL POWERS

BY CHARLES ROSS

AMONG the powers expressly conferred upon the Federal government in the enumerated powers of the constitution is the power "To establish post offices and post roads." This grant of powers so specifically stated is flanked on one side by the power to coin money and provide for the punishment of counterfeiting; and on the other by the power to grant copyrights and patents. It has been the consistent holding of the Supreme Court of the United States that when the Federal Congress by appropriate legislation implements any of these granted powers the Federal regulation becomes supreme and usually exclusive of any state control. This of course is true with reference to post offices, provided for in the same clause with post roads. However limited the term "post roads" may have been in the minds of the authors of the constitution, it has been subsequently held to include all roads and streets used for the distribution of the United States mails. With the development of free delivery in both city and country, practically all highways now come under the broad terms of post roads.

It is a little remarkable that with the constant development of Federal authority throughout the century and a half of our national life that little emphasis has ever been laid upon this grant of power with reference to "post roads."

It is another illustration of the principle, so often demonstrated in the growth of government, that practical and economic considerations usually override and control purely political theories.

The predominant use of public roads has always been and still is local. Before the days of railroads the transportation of the mails and interstate travel were dependent upon public roads. The Federal government encouraged the development of these early "post roads" by direct appropriations, but the actual construction and maintenance and policing were left to the states. With the coming of the railroads, the Federal government transferred its interest from the highway to the railroad as a more practical means of interstate travel.

Not until the coming of the motor vehicle did the Federal government seriously renew its interest in the public roads. The Fed-

eral Highway Act of 1916, revised and rewritten in substantially its present form in 1921, thoroughly established the policy of the Federal government as Federal Aid to the states, and all moneys appropriated for distribution to the states in the nature of grants-in-aid. The wise administration of this act for more than thirty years by the same Bureau Chief, Thomas H. MacDonald, has been on the basis of state ownership, political responsibility, and police regulations; but the Federal authorities have required approved engineering standards as a prerequisite to the use of the proffered Federal Aid. The Federal Bureau has developed on its own initiative improved standards of location, construction, and maintenance, and has acted as a clearing house for the several states and made this information available to them. The Federal agency has likewise been a mediator between the states, assisting in development of appropriate and convenient connections of interstate routes. All this has been done without resort to the constitutional authority to "establish post roads" as the exclusive prerogative of the Federal government.

Practical considerations would seem to make unlikely any conflict between the states and Federal authorities over the right to own, construct, and maintain the public highways, or any considerable proportion thereof. The Federal government needs an extensive mileage for the postal service and also for the purposes of national defense. The use, however, is so intermittent, and so small compared to the local traffic, that it will never be economical to maintain separate systems. The needs of the national government can be achieved by the program of Federal Aid, where the administration of the Federal fund, by the right to give or withhold aid, is made conditional upon compliance with suitable standards.

The indicated conflict between state and Federal authorities is not under the constitutional provision with respect to "post roads," but rather under the commerce clause. This conflict was foreshadowed in recent congressional action regulating interstate truck traffic. Since the motor truck has become such a factor in interstate commerce, regulation by national authority had long seemed inevitable.

The conflict first appeared in the motor vehicle tax laws. Some of the earlier cases emphasized the distinction between taxes levied purely for the purpose of raising state revenue and taxes that partook of the nature of a service charge for the use of the road facilities furnished. The former when levied on interstate travel might be inhibited as constituting a burden upon interstate commerce; but where the state charged for the use of its facilities and the tax

has some reasonable relation to the facility rendered, and especially where the proceeds of the tax were used to improve the facility—to wit, the highways—the tax was universally upheld.

The next field of conflict arose in the matter of Federal regulation of interstate motor vehicles engaged in transportation for hire. The need for Federal regulation in this field, at least in the matter of rates and the character of service, was generally recognized and not resisted by the states. This was made effective by extending to motor carriers the oversight of the Interstate Commerce Commission by the Motor Vehicle Transportation Act of 1938. Certain of the carriers were restive under restrictions placed upon them by the several states, especially in the matter of maximum weights and sizes. The Congress, however, never went further into that field than to direct an investigation. Some of the courts concluded that the Federal authority had been extended into this field; and in the case of Barnwell Brothers *v.* South Carolina Highway Department, the Fourth Federal Circuit Court upheld an order restraining the South Carolina Department from enforcing certain limitations as to weight and width which the Federal court considered unreasonable. Here was a direct conflict with state authority in a plain regulation which the state legislature had determined as reasonable and necessary for the protection of its highways, and here was an effort to substitute for the state's judgment that of the Federal Court as to what was reasonable and necessary.

The Supreme Court declined to take that step, and a very carefully worded opinion by Chief Justice Stone upheld the state's police regulations as in its judgment are deemed necessary to protect its highways. See Barnwell Brothers *v.* South Carolina Highway Department, 303 *U. S. Reports* 177. The same rule has been followed in subsequent cases. Here the matter stands. There is, however, very respectable authority to the effect that the Federal Congress could by appropriate legislation enter this field and a rather widespread belief that, if the several states should unduly hamper interstate travel with restrictive rules, the Federal authority will be asserted to override such limitations.

Another field of possible conflict resulting from this divided authority is in the matter of labor regulations. So far there has been no attempt on the part of the Federal government to regulate wages and hours of labor of the states' own employees. In Overstreet *v.* North Shore Corporation, 318 *U. S. Reports* 125, the Supreme Court seems to hold that the use of public roads by any considerable volume of interstate travel will draw within the orbit of the Fair Labor Standards Act all those who are employed in the mainte-

nance of the road as being employed "in interstate commerce." So far we have found no recognized authority that extends the coverage to the construction of roads not yet open to traffic. Conceivably the act can be so extended, if not by judicial construction, then by congressional action. This would make little practical difference under high-wage, high-employment conditions, but might be the source of considerable concern in a period of unemployment and low wages. States desiring to use highway construction as relief for unemployment would find Federal restrictions as to hours and rates applicable to contract work, and thus uneconomic methods would possibly be invited.

In most states traffic census will reveal that from 80 to 90 per cent of traffic on the highway is local, and it would seem reasonable therefore that the Federal government continue to respect, as much as practical, the states' autonomy in all matters relating to highway construction and policing.

27 THE PERMANENCE OF THE RIGHT OF WAY IN A CHANGING ENVIRONMENT

BY DAVID R. LEVIN

PLANNING for the future must be based upon an understanding of the difficulties, the mistakes, and the achievements of the past. This truism applies nowhere more forcefully than to highway right of way policy and land-acquisition practice in the United States. While our cities and rural areas have experienced profound changes of environment, street and highway rights of way have remained relatively permanent. The emerging problems are many and complex.

The factors of this changing environment are readily discernible, but their implications are not always fully understood. During the past century, the population of the United States has increased more than sevenfold. In that period, the population density has increased from 9.7 to 44.2 persons per square mile. Whereas one person in ten lived in an urbanized area in 1840, a century later more Americans lived in urban than in rural regions.

The horse-and-buggy era has passed, and the automobile has become a flexible, dependable, and relatively inexpensive form of transportation. Its impact on the American mode of life has been profound. Working habits, choice of living quarters, shopping habits, recreational activities, the very pattern of cities, and rural life as well, have responded to its influence.

Four out of every ten communities in the United States depend entirely upon the motor vehicle and the highway system for both passenger and freight service. Three-quarters of all passenger transportation in cities and their suburbs and fully 90 per cent of intercity passenger travel is provided by motor transport. Before the war, 58.7 billion ton-miles of freight was moved over main highways by fast, flexible truck service, while within urban areas, practically all goods in wholesale and retail pick-up and delivery service were moved by truck. Three out of every four farmers in the United States own passenger cars, and over a million trucks are to be found on farms.

This, briefly, is the story of the change in American mobility that has contributed in no small measure to our changing environment. Paradoxically, while many aspects of our living were changing, highway right of way has remained relatively permanent up to the

present time, particularly with respect to location, though somewhat less so concerning its width and character. Typical of this permanence of the right of way in rural areas is the National Pike or Cumberland Road of the 1800's (Figure 1) which today is identified as a portion of U. S. 40 (Figure 2).

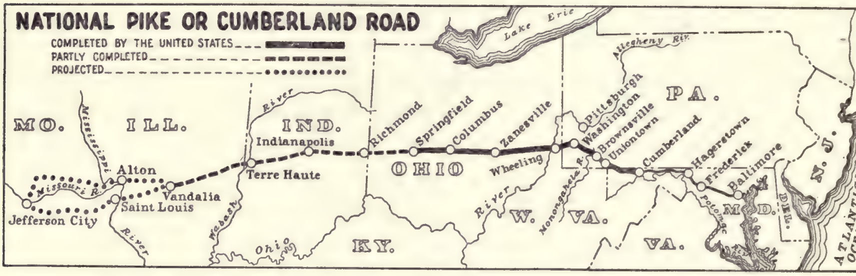


FIG. 1. THE NATIONAL PIKE OR CUMBERLAND ROAD IN THE FIRST HALF OF THE NINETEENTH CENTURY

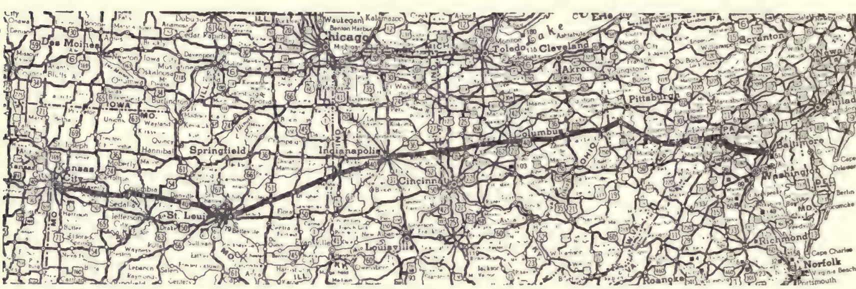


FIG. 2. U. S. ROUTE 40

A portion of present U. S. Route 40, corresponding to the National Pike or Cumberland Road. With the exception of minor changes in alignment, the location of the right of way is substantially as it was a century ago.

The relation between the location of the 1944 recommended Interregional Highway System [1] and historic trails and pioneer roads is significant. The recommended system follows in general the routes of existing Federal-aid highways, and when fully improved will meet to optimum degree the needs of interstate and intercity highway transportation. Its development will also establish a trans-

[1] The National Interregional Highway Committee was appointed by President Roosevelt in 1941 to investigate the need for a limited system of national highways to improve the facilities now available for interregional transportation and to indicate the desirable character of such improvement. Its chairman was Thomas H. MacDonald, Commissioner of Public Roads. Its final report is entitled "Interregional Highways," House Document 379, 78th Cong., 2d Sess.

continental network of modern roads essential to the future economic welfare and defense of the nation. To a remarkable degree, the routes of the recommended system are identical with many historic trails and pioneer roads.

Pursuant to Congressional authorization,[2] the states have designated a national system of interstate highways of 37,800 miles. There is every reason to believe that the initial right of way for these expressways, except for necessary relocations, will in many instances coincide with existing facilities.

Perhaps the most striking illustration of the permanence of the highway right of way in a changing environment is revealed in Figure 3. The principal locations of the main roads in the vicinity of Baltimore, Washington, and Chicago, have remained largely unchanged for a century or more. It is remarkable that in spite of the change in the type of vehicles and mode of propulsion thereof, the routes of highway travel have remained approximately the same.

Why, then, despite the impact of many changes all about, has the street and highway right of way remained so unyielding? There are many reasons.

Highway engineers indicate that fundamentally the principles of highway location have remained unchanged through the years; that the routes of many of our principal roads remain the same because of their general relation to geography [3] and to the population settlements that follow in the path of improved highways. Original construction cost, maintenance expense and land-acquisition costs are still governing factors of highway location. Moreover, in recent years, great emphasis has been placed upon traffic considerations; roads ought to be placed in the prevailing direction of traffic flow which, understandably enough, coincides, at least with respect to the more important routes, with present right-of-way locations. Likewise, land-use patterns, in all types of areas, serve to stabilize road location; and in the past there has been little disposition, with too few exceptions, to alter these patterns, even where doing so would have been beneficial from every point of view. As Figure 3 illustrates so well, urban and suburban expansion—residential, industrial and commercial—requiring suitable road connections with the central city, has generally taken place in close proximity to the existing arterial highways, enclosing these essential routes of travel within their existing rigid right of way shells.

[2] The Federal-Aid Highway Act of 1944, Public Law 521, Chapter 626, 78th Cong., 2d Sess.

[3] This should not be construed as meaning that the principles of highway design and construction have not been progressively improved.

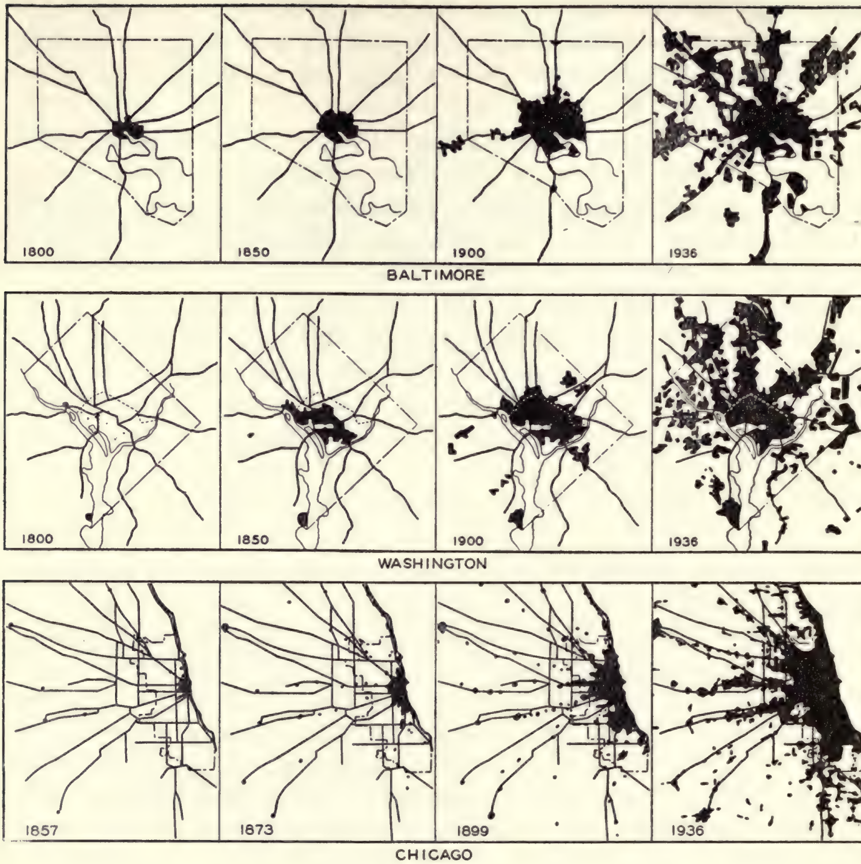


Fig. 3. Influence of Main Roads on City Growth

NEW VERSUS WIDENED EXISTING RIGHT OF WAY

Because of these limitations and the tremendous increases in the number of motor vehicles and their use, highway authorities in recent years have focused their attention upon right-of-way inadequacies. Whereas, prior to World War I, the prevalent width of 66 feet for main routes had been generally considered ample, highway planners soon discovered that greater widths were necessary for higher-speed motor traffic. Though often handicapped by legal restrictions and the lack of popular support of a foresighted land acquisition policy, public authorities sought to remedy the deficiencies by piecemeal widenings of the right of way.

There is ample evidence to indicate that the policy of successive 10-, 20-, and 30-foot widenings has been an expensive one, and in-

adequate as well. Perhaps the most striking illustration of the exorbitant costs of urban street widening is found in Detroit, where three miles of Woodward Avenue were enlarged at a cost of $11,000,000, of which more than $9,800,000 was for the acquisition of land, including property damages. The resulting increase in functional transportation service was probably not commensurate with the cost. It is said that approximately 11 miles of controlled-access highway on less expensive right of way could have been constructed with these funds, with far greater improvement in functional service.

It was estimated that the cost of land for widening the Albany Post Road in Westchester County, New York, from 66 to 166 feet would have been over $792,000 per mile, while land in the same county for the Saw Mill River Parkway of controlled-access design on entirely undeveloped new location and averaging 500 feet in width, cost only $138,000 per mile.

In 1939, the Public Roads Administration investigated right of way costs on the so-called Three-State Highway in Wisconsin and Illinois.[4] Land acquisition costs on a portion of existing U. S. 41 that was widened from 66 to 120 feet averaged $6,404 per mile, while comparable costs on relocated sections of the same width averaged only $3,752 per mile.

Highway authorities are finding that it may be desirable, therefore, to seek new locations for express highways, particularly in the wedges of undeveloped land between the tentacles of development along the main routes radiating from the city, as Figure 4 illustrates. The National Interregional Highway Committee and the Bureau of Public Roads indicate that alignment and right of way width appropriate for new expressways and difficult of acquisition in more developed areas, may be obtainable in these vacant spaces with relative ease and at moderately low cost.

LAND-ACQUISITION FINANCING

Because of existing practice, the huge costs of street and highway rights of way have mounted through the years, particularly in urban and suburban areas. When land was cheap and largely undeveloped, when highway improvements were relatively few in number, the right of way problem was unknown. Owners abutting on proposed street or highway improvements most often donated to the public a portion of their lands for right of way, and even helped to build the road by personal services or through tax assess-

[4] See "Highway Land Acquisition Costs and Practices in Illinois and Wisconsin," *Public Roads* (October-November-December, 1943), XXIV, 253-266.

ments. Special tax payments by all road users were undreamed of. Less than three decades ago intercity travel of the average American was but 450 miles per year.

But today new conditions of financing and travel obtain, and our street and highway needs have grown to tremendous proportions. Before World War II, the intercity travel of an average American was approximately 2,400 miles per year, more than a fivefold increase in mobility in less than a quarter of a century. Land has generally become more valuable, particularly in the regions where transportation facilities are most urgently needed. Abutting landowners no longer contribute substantially to the financing of through-traffic facilities. For it is the motorist, as highway user, who now pays for the roads he travels upon, in the form of gasoline excise taxes, registration fees, and other motor vehicle imposts. Nor does the abutting property owner donate rights of way as a rule. Rather, he is paid handsomely in most instances for such parcels of land as are required for the modern highway, as the figures in the foregoing section demonstrate.

As required by law in some states or existing as established practice in others, many states still permit local units of government to finance or acquire highway right of way for state highways. Because of financial inability or the lack of a substantial concern in road facilities of statewide importance, local authorities have often balked at the provision of any right of way whatsoever, or consenting, have supplied right of way that was inadequate at the start. Some states, recognizing the need for reform in right-of-way policy, are currently reexamining their land-acquisition financing practices, with a view to making them commensurate with modern road requirements.

As an aid in the solution of the right-of-way problem the Congress has authorized, in the Federal-Aid Highway Act of 1944, Federal participation in financing the acquisition of highway rights of way, by redefining the term "construction" to include costs of rights of way, as originally so defined in the 1943 amendment to the Federal-Aid laws. Federal participation is not to exceed one-third of the total land acquisition cost. Consistent with established policy, actual land acquisition activities will continue to be channelized through existing state and local highway departments.

REVISION OF LAND ACQUISITION LAWS AND PROCEDURES

Still another influence has tended to retard the provision of lands adequate for the road improvements that are needed, i.e., the legal and administrative practices that govern the acquisition of rights of

way. State laws and practices of appropriation of lands for public purposes represent the accumulations of more than a century and, except in isolated instances, little revision or simplification has been attempted. While the procedures in some states are models of excellence, policies and practices in many have not always produced the best results.

Too often, short-sighted land-acquisition measures have determined the character of the road. If land acquisition is postponed, as it generally has been, until the very moment it is needed for construction purposes, it is frequently impossible to obtain the needed right of way without long delay and often at great expense. Every aspect of unplanned and improvised methods contribute to ill-advised uneconomic compromise.

The diversity of land-acquisition methods, most of them time-consuming and expensive, is a primary obstacle. There are no less than 320 such methods in the United States. While some of these are fundamentally sound, many postpone the public possession of the desired lands until compensation has been determined, often involving prolonged contests in the courts.

The customary procedure in many jurisdictions is an involved process. After necessary preliminaries, the public authority seeks to purchase a property through negotiation for a price that may or may not have been determined by scientific pre-negotiation appraisals. Sometimes, provision is made for the appointment of an appraisal commission consisting generally of three members; their hearings are often unreasonably prolonged. If the power of eminent domain must be resorted to, the condemner invokes the formal legal machinery by service of a petition upon the owner of the condemned property. The court after hearing the evidence determines, with or without a jury, what the just compensation for the property shall be, and title passes after the award has been paid the owner, unless by statute it passes upon grant of possession and right of entry. Appeals taken from these decisions may further prolong the litigation.

There have been developed in recent years, however, a few essentially similar methods that expedite the acquisition of lands by public authorities and yet protect the rights of private property owners. Under these methods, after required preliminaries, the public authority merely files a plat and description of the property to be taken and, after notice to the owner of such action, the appropriation is deemed to be complete and title to the property vests in the state. If offers of the acquiring authority are rejected, the former owner must file a claim for the value of the property in court, which

makes an award after hearing all the evidence. For almost two decades this method has been used successfully by the State of New York in its grade-crossing elimination program, and this same technique has been extended to apply to the state system of highways by the 1944 New York Legislature.

Revision of public land-acquisition procedure in many states would involve legislative provision for a single method of acquiring lands for highway facilities, or for all public purposes, to be substituted for the diverse procedures now in use. Particularly the right of immediate public possession of lands should be granted by law, with adequate safeguards to protect the private property owners. Provision should likewise be made for the acquisition of needed lands for highway rights of way sufficiently in advance of construction. In addition, statutory maximum right of way width limitations, found in many states, should be liberalized or eliminated entirely, thus allowing highway right of way width to be related more closely to present and anticipated traffic requirements.

THE PARKING PROBLEM

The right of way of the average city street is utilized not only for the movement of vehicles, but as a terminal for them as well. Because ever-increasing thousands seek to use their motor vehicles for travel in our cities, from origin to destination, street congestion has become a matter of serious concern. In the central areas of some of the more important urban communities today, the quickest form of surface travel is often achieved by the pedestrian, while long lines of high-powered, streamlined vehicles remain hopelessly jammed in obsolete streets (see Figure 5).

The want of sufficient street width is a primary cause of this congestion in urban areas. The already inadequate street capacity is further reduced by vehicles parked along the curbs, and by the maneuvering of motorists who seek parking facilities. Investigation reveals that regardless of the width of a downtown street, curb parking reduces its capacity by an amount varying from 43 per cent for the wider streets to 47 per cent for the narrower streets. Recognizing the urgency of the need, a few states and local units of governments have enacted appropriate legislation for the public provision and regulation of parking accommodations. Even some of these enactments have already proved inadequate.

There is urgent need, therefore, for legislative action in most states to recognize the provision of terminal facilities as a public use, and to grant the necessary authority for their establishment and support by state and local bodies. Methods of public control

that will foster the provision of parking facilities, public and private, resulting in maximum utilization at minimum cost, will have to be developed soon. A bold yet realistic parking policy must be established and executed.

CONTROL OF LAND USE

The discussion thus far has dealt with the problem as it concerns the street or highway right of way itself. It is becoming increasingly apparent, however, that reasonable public control of lands adjacent to our main highways is necessary, to preserve the efficiency of the motor vehicle and to protect the highway from early obsolescence. The tendency toward encroachment of the right of way and ribbon development along the highway margins has become aggravated in recent years, as Figure 6 reveals. It is little wonder that a given highway right of way, calculated at the time of its establishment to serve adequately for a number of years, is found progressively to be more and more inadequate.

The nature of this special problem is presented in greater detail elsewhere. Suffice it here to say that highway management is beginning to realize that public control of the road margins is just as important to the preservation of the highway as a corridor of travel as are matters concerning the right of way itself, the design details, and construction practices.

CONCLUSION

Dynamic physical and economic forces are constantly changing our environment. The power age, the coming of electricity, improvements in communications, the motor vehicle—all have contributed to render inadequate today that which was satisfactory yesterday. One such outstanding inadequacy with respect to our road system concerns the street and highway right of way.

While some public authorities have been fully alert to new needs and have sought to supply them by appropriate action, many have been content with piecemeal palliatives that in the end have resulted in costs that were higher for transportation service that was poorer.

It must be admitted that we have been muddling along in our highway land-acquisition activities. Though the task is a difficult one, the time is ripe for decisive action in the provision of rights of way adequate for the highways of tomorrow.

28 THE PLANNING OF THE HIGHWAY

BY G. DONALD KENNEDY

THE history of highway planning in America since shortly after the turn of the present century has been that of constant effort to catch up with the increasing demands of motor traffic.

In the early days of road building, planning was decentralized, done by state and local government agencies. With minor exceptions, such as roads in certain Federal land areas, there has been no Federal building of highways in America since 1861, when the era of Federal turnpikes and major Army road projects ended. The responsibility has rested with the state and with the various local jurisdictions.

Looking back, one can see mistakes that were made in highway planning. It could not be foreseen, for instance, that motor traffic would rise 1,000 per cent between World Wars I and II, making early road designs unsafe and inadequate. But even if this vast increase in traffic could have been foreseen, it would have made little difference. Funds for highways always have been inadequate to meet recognized needs. In highway planning the first requisite in the past was to spread available funds thinly, to satisfy the elementary road demands of a nation undergoing a change from horse-and-buggy to motor transportation.

The over-all verdict with regard to the past must be that a monumental pioneering job was done. Road and street work made up almost half of all public works in America in recent decades, and the normal yearly road and street budget was some $2½ billion.

The bulk of this cost was paid by motorists themselves, through gasoline, license, and other special taxes which averaged well over $2 billion a year by 1941, and which declined only slightly during wartime years.

STATE HIGHWAY PLANNING SURVEYS

Highway planning was not a complex operation in most areas of the nation until after about 1925. The first need was for surfacing main rural roads connecting cities and towns. This initial need was recognized in a "stage construction" program of state, Federal-aid, and county road systems, bringing about the improvement of a large trunk line mileage at a faster rate than any other method could have achieved.

State and Federal-aid highway planning formerly stopped at city limits, and also did not extend to secondary rural roads. The urban streets, and the secondary rural routes, were considered as primarily land-access facilities, subject to improvement through local property taxes.

The rapid growth of traffic brought new problems: a demand for extension of all-weather surfacing to a larger rural mileage; a need for modernizing the older main rural trunk lines to make them safer and increase their traffic capacity; and a critical problem of urban traffic congestion on city street systems laid out for horse-and-buggy travel.

The net effect of these pressures was to spread highway funds more thinly than ever before. Construction and modernization began falling steadily behind traffic needs after 1929. Maintenance and debt-service costs were rising as the highway plant grew larger. Diversion of motorist tax revenues to non-highway purposes further depleted the road construction funds.

Meanwhile, traffic continued to increase during the depression years, and congestion and accidents became problems of national concern.

Thus there came about, in 1934, the start of the nation-wide state highway planning surveys, under the Federal-aid highway program which had guided state highway development soundly since 1916. These surveys, now a continuing operation in all states, were divided into three sections:

1. A highway inventory, covering every mile of public road: mileage, surface type, width, grades, sight-distances, curvatures, railroad grade crossings, drainage, bridges, and kinds of thoroughfare. These data were put on comprehensive maps county by county.

2. A traffic survey, showing the character and extent of traffic on the roads, and the size and weight of vehicles. These studies are of growing usefulness in predicting future traffic loads.

3. A financial survey, of four parts:

(a) A fiscal study—revenues and expenditures of the state and its subdivisions, for highways, education, welfare and services, and general government. The highway revenue surveys are continuous, to determine future trends.

(b) A road-use study, to develop the relative use of each road system by urban and rural residents, and origins and destinations of trips involving rural highway use.

(c) A motor vehicle allocation study, to determine the situs of ownership of motor vehicles in the state, and the uses made of passenger and commercial vehicles.

(d) A road-life study, to determine original and maintenance costs and the life of each type of surface in the state.

These original planning surveys included, in most states, no detailed urban studies. However, their net effect was to point to the need for attention to the urban highway problem.

About half of the State Highway Departments now have undertaken comprehensive urban traffic origin-destination surveys, covering all forms of urban transportation and providing basic information to guide the location and design of urban traffic facilities which will benefit the greatest possible number of motorists and truck operators.

From the planning studies were developed important facts on traffic, never before known. It was found that the average highway trip is very short—well under 10 miles; that half of all miles of motor travel in the nation is on city streets; and that four of every five vehicles on all rural roads are headed for a city or coming from one.

It was found that traffic increases *only* near a city, and reaches a downtown peak about six times as high as at the urban outskirts; and that local and outside traffic are both headed for the same urban destinations in almost identical percentages—the downtown area, the main residential districts, the industrial and commercial regions, and other main destinations. Only in towns below 2,500 population, on the average, was it found that even half the traffic intended to by-pass the urban area entirely.

CLASSIFICATION OF ROAD SYSTEMS

From the outset of modern highway planning, it was recognized that rural roads should be classified in three systems: primary trunk lines, which exist mainly for general traffic movement; secondary roads, which branch off of the primary network and serve a lesser volume of general traffic, more local in character; and tertiary or land-access routes, which have no general traffic value but exist primarily to give access to individual property.

Systematic classification has been a major objective of the Federal-aid highway law since 1921. The states select 7 per cent of their public roads, forming a connected state and interstate network. All Federal-aid highway funds formerly were limited to this system.

The states plan and execute all Federal-aid projects, subject to approval of projects by the Bureau of Public Roads (formerly the U. S. Public Roads Administration), and the states pay half the construction costs plus all maintenance costs.

This state-Federal highway program, a model of coordinate planning and achievement, was revised in 1944 to take into account the facts developed in the state highway planning surveys. Under the 1944 Federal-Aid Highway Act, which took effect at the close of World War II, the Federal-aid road program was broadened to give more recognition to urban and secondary rural road needs, and to permit modernization of the original seven per cent Federal-aid system.

Three road systems are included in the 1944 Act:

1. The Interstate Highway System, with 1 per cent of our road mileage, which will carry 20 per cent of all future traffic in the nation. This is a national network of the heaviest traveled intercity routes in the nation, which will be improved over the years to design standards looking twenty years ahead to traffic needs of the future. The network passes through all cities of 100,000 or more population and through nearly half of all cities over 5,000 population, as well as all major agricultural, industrial and national defense centers.

2. The original 7 per cent system of primary rural and urban Federal-aid roads, which will be improved to modern standards on a long-range basis. This system carries some 35 per cent of all rural and urban travel.

3. A Federal-aid secondary road system, to take in the chief farm-to-market routes of the nation. The mileage is not yet determined, but ultimately this system may contain 30 per cent of all roads—a million miles in all. If so, it will carry 25 per cent of all traffic.

This would leave some 62 per cent of all roads and streets outside the Federal-aid system. But these routes would carry only 20 per cent of all traffic—averaging 17 vehicles a day per mile in rural areas, and taking in city streets that serve as land-access routes rather than for general traffic movement.

The state-Federal highway program thus becomes an instrument for development of a completely integrated system of state and local roads and streets—systems planned and improved by state and local governments, with basic uniformity but much local latitude in design standards.

In urban areas particularly, this classification of main, secondary, and land-access streets, with appropriate design standards for each, will be a desirable and inevitable outgrowth of the new state-Fed-

eral road program. Such system classifications have been sorely needed in larger cities.

PRACTICAL BASIS FOR PLANNING

Once such system classifications are made, the foundation for long-range planning of highway improvements is laid. Original and maintenance costs per mile can be estimated, priority given to most urgent needs, and an orderly annual program can be carried out on the basis of available funds.

The Federal-aid program, totaling $450 millions a year under the 1948 Act, is subject to 50-50 state-Federal matching on planning and construction costs. Federal funds also may be used for a third of right of way costs for approved projects. This $450 million total is only a seventh of the estimated total yearly postwar highway budget, but past experience indicates its benefits will be far beyond the actual funds involved.

The bulk of state-local highway funds goes for maintenance, debt service, and routine improvements. Federal-aid funds are reserved for major construction projects—for trunk line routes that form the backbone of the entire highway and street network.

Furthermore, state and local governments always spend far more of their own money on Federal-aid routes than does the Federal government. Thus the broadened Federal-state highway program tends to concentrate large sums on the most important roads and streets of the nation, which serve the vast majority of motorists; and tends to encourage adequate design standards and sound planning on a local basis.

URBAN MASTER PLAN

In urban areas, the master plan for the future is laid down in detail in the 1944 report of the National Interregional Highway Committee headed by Commissioner Thomas H. MacDonald of the Bureau of Public Roads. This report was the basis for the Interstate Highway program approved by Congress and the American Association of State Highway Officials and now under actual construction.

Traffic origin-destination points, and the encouragement of desirable urban land-use patterns, became the yardstick of the Interregional Highway Committee recommendations on urban highway planning.

The general plan for a large city calls for express highways laid out somewhat like a wheel—a downtown loop, another loop around the metropolitan outskirts, and several "spoke" routes connecting

the two loops. A ring of free or low-cost parking lots would be located alongside the downtown loop, to encourage all-day parking outside the congested center.

This scheme, adaptable to all large cities, permits traffic to reach any urban point with a minimum use of local streets, and also permits by-passing of the downtown or total urban area. Downtown, traffic enters and leaves over a number of internal streets which tap the expressway loop at various points—avoiding the chaos that results when expressway traffic is "dumped" at a single point into the ordinary street system.

The outskirts loop opens up for settlement the wedges of land between the "spoke" routes, to promote a compact development of the urban area in contrast to the "explosion" out along main radial routes, which has occurred in the past.

A series of small off-street parking facilities scattered through the downtown area, and possibly one or more mid-town loop expressways for large cities, completes the basic plan.

For medium sized metropolitan areas, a less complete expressway plan is needed—normally just two routes crossing east-west and north-south through town and intersecting along one edge of the business district so the routes form boundaries around two sides of the business district; plus a loop expressway around the urban outskirts. In smaller cities, one route through the heart of town, and an alternate by-pass, may serve all major traffic needs.

Since the origin and destination of traffic is the important factor in route location, and since expressways do not give direct access to adjoining land, existing main streets need not be used for the new routes—indeed, seldom can be converted into safe and high-capacity traffic carriers.

The root of urban congestion and accidents is the street intersection. The Interregional Committee recommended that locations be chosen, where possible, to minimize the intersection problem—such as along waterfronts, on the edge of park areas, through wedges of undeveloped land, and so on. Blighted land also can be used frequently, serving the dual objective of urban rehabilitation and lower right-of-way costs.

In highly developed sections of the city, the only practical general solution is to take a series of city blocks, building the expressway in open cut, and leaving the local streets on each side for local access purposes. This provides sufficient land for side slopes and access ramps, and leaves occasional strips of land which can be landscaped or put into parking use. The expressway thus underpasses all cross-streets.

Less costly, when the local situation permits, is the plan of building the expressway at grade for the most part, and closing all but important cross-streets. Pedestrian cross-over facilities are needed at frequent intervals, however.

Within the local urban street system, modern subdivision zoning and platting regulations are urgently needed—promoting winding, dead-end streets, central location of neighborhood cultural and service facilities, and use of arterial streets as neighborhood boundaries. Hard and costly to achieve in existing neighborhoods unless they are completely rebuilt, such principles are practical and economical to apply in new subdivisions. Less land is needed for streets, original and upkeep costs are lower, and neighborhood values are permanently protected from the blight and hazards which follow the use of neighborhood streets by heavy traffic.

Modern traffic needs are not met by improving *many* streets to serve traffic movement. Rather, traffic prefers to concentrate on a very limited number of streets leading to major destination points —and *does* concentrate on such streets, until sheer congestion on streets not designed for large traffic volumes forces motorists to spread out to alternate routes.

The express highway design, with control of access, permits one traffic lane to carry, at steady speeds, upwards of 1,500 vehicles per hour—or a number equal to the average traffic capacity of the ordinary wide main city street, where intersection delays, parking maneuvers, pedestrians, and other conflicts cut heavily into the safety and capacity factors.

In addition to the expressway network, most large cities need more intensive use of traffic-engineering devices to improve the safety and efficiency of secondary arterials, under a major street system plan. One-way streets, proper traffic-light timing, channelization and intersection redesign, and various types of restrictions on certain turning and cross-traffic movements, all are essential elements of a practical urban street planning program.

On rural trunk lines in a growing number of states, data gathered in the state highway planning surveys are being used to guide a long-range modernization program. Essential factors here are the need for rebuilding worn-out surfaces; for at least 22-foot widths on lightly traveled two-lane trunk lines, and 24 or more feet on heavily traveled routes; and for modern gradient and curvature.

In addition, Interstate System routes and others of corresponding importance often must be relocated on new rights of way, in order to serve traffic needs better and to obtain sufficient land for divided roadways and to permit control of the type of roadside develop-

ments which frequently destroy traffic capacity and create excessive hazards.

On the rural secondary system, often called "farm-to-market" roads, one planning objective now widely recognized is that of promoting a desirable and economical land use pattern.

County farm organizations are joining with highway agencies and other technical advisors in reviewing their existing road classifications in this light and with reference to financial ability to provide and maintain all-weather surfacing for the complete secondary road system in a reasonable number of years.

PREPARING FOR FUTURE TRAFFIC

Road and street planning in America is carried out through 35,600 state and local agencies which collect and spend money for highway purposes. The state highway departments are the central agencies in most of the activity, and their responsibilities have increased since the broadening of the Federal-Aid Highway Law.

Within a few months after World War II ended, traffic was back at 1941 all-time peak levels, as the trend toward greater travel per vehicle per year was resumed after the ending of gasoline rationing. Most traffic authorities agree that by 1970 traffic will be about 25 per cent above present mileage. This will mean even greater increases on main roads and streets, which always obtain a disproportionate share of any general traffic increase.

Highway planners also recognize that when a given route is improved it attracts traffic from other routes—the principle being that the improvement increases the lateral distance motorists will drive in order to use the better facility.

Agitation for extensive toll-highway financing has been counteracted by objective studies which showed that such proposals were generally not feasible—aside from the inequity of assessing another toll on top of the special tax tolls every motorist pays in buying gasoline, vehicle licenses, and in other ways.

The challenge in highway planning immediately after World War II was to make a start on a long-term modernization program based on the use of proper design and location standards as dictated by the nationwide highway planning surveys carried out since 1934—a program taking in urban arterials, main rural trunk lines, and a vast mileage of farm routes which as yet have not had all-weather surfacing.

The master plan, and the planning tools, were available in the state-Federal highway program and in the modern techniques being used by the Bureau of Public Roads, the state highway depart-

ments, and a growing number of local highway agencies which are working in close cooperation with the state-Federal highway program.

Such a program requires a restriction on many former practices: especially the haphazard spreading of highway funds over so large a mileage each year that no important improvement can be made anywhere; and the diversion of highway taxes to non-highway purposes and other fiscal abuses that threaten the self-supporting nature of the vast public utility of roads and streets. Positively, it requires Federal, state, and local cooperation in planning and financing of the vast long-term program; more attention to the ability of highways to promote economic and desirable land-use patterns in urban and rural areas; and local public assumption of responsibility to solve the critical downtown parking problem.

Substantial progress was made in meeting practical and complex problems during the first year after the end of World War II, when the nation resumed a highway program which had been interrupted for the first time in this century.

Highway planning in America, while still somewhat spotty in certain areas, was on a firmer basis in the year 1949 than in any past period. Every indication is that a new era of road building began with the close of the Second World War, and that our roads and streets of the future will benefit from the lessons of the past.

29 THE DESIGN OF MOTORWAYS

BY GILMORE D. CLARKE

IN AN address before the 91st Annual Meeting of the American Society of Civil Engineers, Thomas H. MacDonald, Commissioner of the U. S. Public Roads Administration, said in part: "The national system of interregional highways proposed, within the limit of mileage adopted, connects the larger cities and metropolitan areas, directly joining region with region and major city with major city. For this reason, although in miles it represents one per cent of the entire highway and street system, it will probably accommodate not less than 20 per cent of the total street and highway traffic. Intensive study has revealed that any other system, either materially larger or smaller than that proposed, would have a lesser average utilization. Accordingly, the system mileage as proposed may be accepted as close to the optimum mileage which will afford the greatest public service per mile. To start with, a system of approximately 34,000 miles has been tentatively designated, of which some 4,500 miles is urban . . .

"Our cities are worth preserving. The gradual remodeling of the existing amorphous city structure into neighborhood cells is both logical and natural. The city will always form the vital nucleus serving the essential needs of the metropolitan region. Because the building of highways and streets exerts such a profound influence upon urban life, the proposed interregional highway system may well constitute the key to the functional rebuilding of our cities. But the cities themselves must recognize that, while opportunity is at hand, they must exploit it to the fullest if they are to survive. Like the Greeks, they must consciously endeavor to create acceptable and convenient surroundings for life."

It has been suggested that the rapid development of the means of travel by air will make unnecessary a large expansion of the highway system of the nation; yet, in spite of phenomenal progress in the design and manufacture of aircraft, we shall continue to expand the use of the motor vehicle. The design of the motorway, however, must be thoroughly modernized in order that it may be made both adequate and safe for the vastly increased use to which it will be subjected; the motorway must be at least as modern as the vehicles which move over it.

The modern motor vehicle has been developed for movement at

high speeds, and this factor, probably more than any other, influences the geometric design of the motorway. The consideration which must be given to those factors which make for the safety and the convenience of the motorway requires greater attention to details than ever before on the part of the designer.

The Public Roads Administration (now the Bureau of Public Roads) has indicated that "90 per cent or more of our highways will probably be of the two-lane, two-way highway, because the motor vehicle traffic thereon will not justify more," and that "the mileage of four-lane highways in rural areas can be expected to increase gradually with the anticipated rise in traffic volume. It is now universally recognized that any four-lane (or six-lane) facility should be constructed as a divided highway with as wide a median dividing strip as may be feasible. In other than flat terrain this logically leads to design without a fixed cross-section, that is, two one-way roads with separate alinement and profile to best fit the terrain and a resultant variable median strip."

In certain areas the highway, as we know it, is outmoded. In the future, the important through-arteries approaching, connecting, and passing through or around large centers of population will be designed as expressways or as parkways, as may best suit each separate situation. These through-arteries will be insulated from the border lands, much in the manner of railroad tracks, by strips of land along each side of the roadway across which the owners of abutting lands will be denied access.

The expressway is a motorway which has been developed out of the experience gained in the planning of highways and parkways. The highway may be described, to use the words of Edward M. Bassett, as "a strip of land dedicated to the movement of vehicles over which the abutting owners have the right of light, air, and access." The owners of the border lands along a highway have free access to the roadway pavements, and points of ingress and egress are, therefore, more or less unlimited. The parkway, which was developed before the expressway (sometimes called throughway, limited-access highway, or freeway), may be described as a "strip of land dedicated to recreation over which the abutting owners have no right of light, air, or access." Lands acquired for the parkway are of sufficient width to provide border strips of varying widths each side of the motorway drives. These so-called "shoestring parks" thereby insulate the interior motorway or motorways, and thus prevent ingress and egress from border lands, except at specially designated points. Since the parkway is "dedicated to recreation," only passenger cars may travel over the motorways built within the

borders of this type of facility. The need was felt for a facility which incorporates most of the features of the parkway yet provides motorways for use by commercial vehicles as well as by passenger cars; hence the expressway was developed. This facility may be described as a "strip of land dedicated to the movement of vehicles over which the abutting owners have no right of light, air, or access." It is the purpose of this chapter to review the basic principles which govern the design of expressways.

In order that the expressway may provide the best possible influence upon abutting lands, the areas between the express roads and the bordering service roads or bordering private lands should be graded and planted in much the same manner as for a parkway. It is well to remember that, while the expressway serves as an artery for commercial as well as for passenger vehicles, less than 20 per cent of the cars will be commercial, and on Sundays there will be practically no commercial vehicles at all. It is desirable, therefore, to incorporate in the expressway practically all of those features which distinguish a parkway.

Hereafter the engineer must give greater attention to those factors which improve the appearance of all types of motor arteries, for almost every element introduced which improves the appearance, also improves efficiency and safety. For example, roads constructed on long tangents are more dangerous for traffic than those built on long easy spiraled curves; in the interest of safety, "roller-coaster" profiles, the result of building roads on long tangents in rolling or in hilly country, should not be tolerated; and tangents between curves in the same direction, creating so-called "flat wheeled" curves, are generally undesirable. The side slopes along the border of roads should be flattened to prevent erosion, and all structures, including bridges, should be carefully designed with due regard for the aesthetic as well as for the more practical engineering factors. These, and other important considerations, such as the elimination of the billboard nuisance, the ugly gas station, and the equally obnoxious hot-dog stand, should be taken into account in connection with the design of all motorways if we are to keep pace with the development of the modern motor vehicle.

The following standards are appropriate for use in the design of expressways within large cities, in their environs, and those which serve as connecting links between large communities; together these elements form a part of the network of motorways which ultimately may cover the entire area of the United States.

WIDTH OF RIGHT OF WAY

The width of the right of way should be sufficient to provide for (a) a separated pavement of four or six 12-foot lanes (depending upon the predetermined traffic volume), two or three for traffic in opposite direction; (b) a median strip of variable width (6-foot minimum); (c) width for deceleration and acceleration lanes at points of access with intersecting arteries; (d) two 10-foot shoulders for disabled cars; (e) wide, flat slopes; (f) ramps; (g) walls; (h) service streets, where necessary; or such of these facilities as may be required at any particular point. In any case, the right of way should be of a minimum width of 200 feet, where service roads are not required, and a minimum of 300 feet, including service roads, where such roads are necessary. The right of way should vary in width so as not to leave small and otherwise more or less useless remnants of parcels of private land along the borders. In general, the taking lines should be located back of the tops of immediate steep slopes. The width should vary as the cost of the land; where land is cheap, the right of way may be wider to include stands of trees or other valuable natural features; where it is expensive, the right of way may be narrower.

NUMBER AND WIDTH OF TRAFFIC LANES AND MEDIAN STRIPS

The width of the pavement depends upon the anticipated volume of traffic which the route will be called upon to carry. Three lanes for traffic moving in each direction, a total of six lanes, is the width necessary on urban projects expected to carry an average daily traffic of 20,000 or more vehicles. Each lane should be 12 feet wide, making the total pavement width 72 feet; the two roadways, each made up of three lanes of pavement 36 feet in width for traffic moving in opposite directions, should be separated by a median strip of variable width but of not less than 6 feet. This strip may reach the greatest width at points about half way between bridges that are some distance apart, a variation which adds both to the attractiveness and to the safety of the expressway. In rolling topography, or where it is necessary to construct expressways on side slopes, the roadways may be separated for wide and varied distances so that the profile of one roadway may be at a higher elevation than the other, the median strip taking up the difference in grade by providing adequate shoulders along the two pavements with a flat slope (one-on-three or flatter slope desirable) between.

At the beginning it may be deemed wise to construct only four lanes on potential six-lane expressways. In this event, however,

BEFORE RIBBON DEVELOPMENT

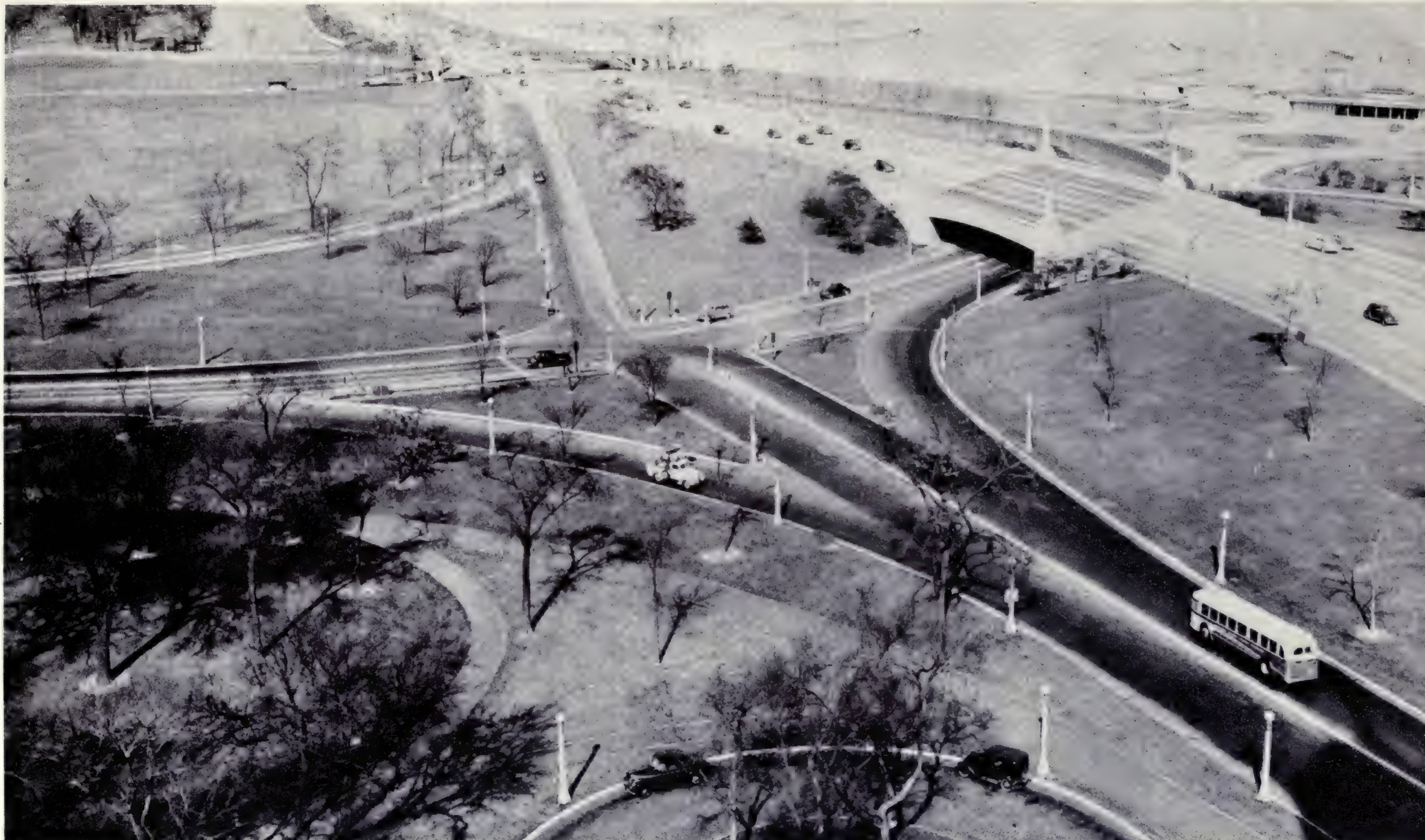
A section of U.S. 99 (State Highway No. 4) south of Modesto, California, after its construction in 1932.

AFTER RIBBON DEVELOPMENT

The same portion of the highway in 1938, transformed by roadside development into a 20-miles-per-hour zone.

PUBLIC ROADS ADMINISTRATION

MERRITT PARKWAY NEAR NORWALK, CONNECTICUT
This controlled-access toll facility is a favorite of tourists entering New England from the southwest.



PUBLIC ROADS ADMINISTRATION

OUTER LAKE SHORE DRIVE, CHICAGO

Motor vehicles have orderly access to and across the expressway. A pedestrian overpass may be noted in the middle distance.

PUBLIC ROADS ADMINISTRATION

SHIRLEY MEMORIAL HIGHWAY, ARLINGTON, VIRGINIA

This view is looking toward the Pentagon Building and Washington. Farlington and Parkfairfax housing developments are in the middle distance. Public control of access insulates the road from its adjoining land uses, yet serves them effectively.

bridges for six lanes should be constructed and the full width of the subgrade for six lanes should be prepared at the outset.

SHOULDERS: ACCELERATING AND DECELERATION LANES

Shoulders 10 feet wide should be provided on one side (outside and to right) of each roadway. Thus the graded width for the pavement (6 lanes), the minimum median strip (6 feet), and two 10-foot shoulders total 98 feet. The shoulders are necessary for the temporary accommodation of disabled or other stationary vehicles; and wherever possible, they should be provided for the full length of the project, including on and under bridges and grade-crossing-elimination structures. Curbs separating the outside lane of pavement from the shoulders should not exceed 6 inches in height and should be sloped so as to be mountable.

"The uneconomical and annoying delay to traffic by trucks creeping up long grades will be overcome to some extent by greater climb ability of trucks and to a considerable extent by providing separate additional lanes for trucks on upgrades. Such additional lanes of a color contrasting with the normal pavement have been used in two-lane pavements in several states and a high degree of compliance by truck drivers is reported. Their use on four-lane highways is not out of line, for the capacity of any road is materially reduced by trucks moving very slowly. The added lane on upgrade brings the capacity of that section of road in balance with other sections."[1]

SERVICE ROADS AND SLOPES

In built-up sections, service roads may be required along each side of the right of way. These will facilitate exit from and entrance to the expressway. They should be designed 34 feet in width to provide for one lane of parked cars and two moving lanes of traffic. In thinly populated sections the service roads may be narrower. Slopes between the expressway drives and the service roads or between the expressway and the property lines, should be on easy gradients so as to prevent erosion; a one-on-two slope should be the steepest permitted, with flatter slopes preferable. In rock cuts, slopes will either be eliminated or made to suit the special conditions encountered.

[1] Joseph Barnett, "Picture of Postwar Traffic: The Highway," *1944 Proceedings Inst. of Traffic Engineers* (New York, 1945).

ALIGNMENT AND HORIZONTAL CURVATURE

The alignment should be of as high a standard as feasible. The speed assumed for design purposes should be as high as practicable, consistent with the topography, the proximity of urban improvements, and the expected traffic volume. It is reasonable to state that speeds in excess of 50 miles per hour will usually be found to be impracticable. While it is axiomatic that horizontal curvature should be of the lowest practicable degree, a rate of curvature of 3 degrees or less is thoroughly satisfactory. This standard permits traffic to move safely at speeds up to 75 miles per hour, a speed somewhat in excess of the desirable maximum.

Curvature is predicated upon the maximum speed allowable. It would seem reasonable to design for a maximum speed of, let us assume, 65 miles per hour. This means that some vehicles may travel that fast, at times, but the ruling speed will probably be between 40 and 50 miles per hour. Based upon this assumption, an absolute maximum curvature of 5 degrees, with a desirable maximum of 4 degrees, is practicable. These standards, while reasonable, provide excessive curvature for the most important arterial highways in the rolling terrain along the Atlantic seaboard; wherever practicable, a maximum curvature of 3 degrees with the desirable maximum of 2½ degrees, is recommended. An expressway alignment which retains a maximum of 3 degrees curvature will, in so far as we are now able to foresee, stand the test well over a long period of time.

It is reasonable to believe that roads cannot be designed to be safe for the general public to travel at speeds in excess of 65 miles per hour. In an article entitled, "Tomorrow's Cars and Roads," Robert Moses, chairman of the New York City Parkway Authority, stated, "Thirty miles an hour on the average boulevard is plenty in cities, forty is enough in the suburbs, and fifty should be tops anywhere in the country, no matter how open and thinly populated. My idea of futility is to build a beautiful parkway for speed demons who can't tell a flowering shrub from a bale of hay."

Many highway engineers still advocate long, unbroken tangential alignment in rolling as well as in more or less level terrain. Roads of this character are monotonous to drive over, dangerous (particularly at night when headlight glare may be seen for long distances), usually disregard valuable features of the terrain, and often create large, irreparable scars in sections of excessive cuts and fills. Unless the gradient is more or less level or unbroken, an up and down "roller-coaster" alignment prevails; this is unpleasant

to drive over, and danger lurks at one side of every vertical curve. For these reasons, a generally curved alignment on standards herein outlined is advocated.

A number of experienced highway engineers share the view that roads constructed on long, easy curves are safer than those constructed on long tangents. The record of accidents on the highways and parkways of New York State indicates conclusively that the large majority of fatal accidents occur on long tangents where excessive speeds are possible and where the drivers are not always alert. While this evidence is not necessarily conclusive, it strongly suggests that the introduction of curvature in road alignment carries with it a measure of insurance against accidents. Moderate curvature promotes alertness and relieves the monotony of driving.

TRANSITION CURVATURE

All horizontal circular curves, sharper than 2 degrees, should be approached by transition curves of a length consistent with the design speed and sufficient to permit the attainment of full superelevation within the length of the transition. Tangents of appropriate length, together with transition curves between all curves in opposite directions, are advocated. Tangents between curves in the same direction should be avoided except in cases where the tangent is so long that the two points of curvature cannot be seen one from the other.

SUPERELEVATION OF CURVES

All curves, sharper than 1 degree, should be superelevated. The maximum superelevation should be 0.12 per foot; 0.08 per foot of superelevation should not be exceeded where a slippery condition of the road is likely to exist. On all curves the superelevation should be such as to counterbalance completely the centrifugal force of a vehicle traveling at three-fourths of the design speed of the road, but not to exceed the stated limit. Superelevation should be obtained gradually, and in such a manner that the difference in slope between longitudinal profiles separated by the width of one lane shall be not greater than 1 in 200.

GRADIENT

The gradient of the roads should be adapted to the surrounding topography, the volume and type of traffic, and the relative necessity for passing trucks and tractor combinations. A maximum gradient of 3 per cent is desirable for an expressway and, wherever possible, should not be exceeded.

BRIDGES AND GRADE CROSSING ELIMINATION STRUCTURES

"Greater attention will be paid to the amenities than heretofore. Grade-separation structures will come into common use. Unlike river bridges, these are seen by the driving public and there is no less justification for making them architecturally excellent than in constructing a public building, particularly when structures are achieved by attention to line and detail which need not necessarily increase the cost." [2]

Bridges should be designed to fit the predetermined alignment and gradient of the roadways. While structural and architectural requirements may necessitate certain adjustments, these should not cause the lowering of expressway standards.

The distance between the face of the curb and the bridge abutment, pier, railing, or parapet, should be not less than 3 feet on the left side of the expressway and 6 feet on the right side. Where possible, the shoulder should be carried under or across all bridges when accelerating and decelerating lanes are not provided.

The width of the median strip over bridges, or under bridges having a clear span over both roadways, should be not less than 4 feet.

Where access drives between intersecting highway and the expressway occur, as in the vicinity of grade-crossing-elimination structures, it will probably be necessary to widen the spans and to increase the width of the structures by two full lanes in order to provide for decelerating and accelerating lanes over and under the structures on both the expressway and the intersecting highway.

A minimum vertical clearance of 14 feet should obtain for all grade-crossing-elimination structures.

ACCESS FACILITIES

Many different types of access facilities are possible of development. In no case should left-hand turns be permitted on the expressway. Access drives connecting the intersecting or border streets and the expressway should be between the outside or the slow-moving expressway lanes and the border streets; this design policy is in the best interests of safety. Acceleration and deceleration lanes are recommended on the expressway so that vehicles may slow down or increase speed in a lane independent from the moving traffic lanes, before slowing down to turn out or before increasing speed upon entering the expressway.

[2] Joseph Barnett, *op. cit.*

"Probably the most spectacular phases of motorway design in cities will be at points of interchange. Where parallel service roads are used they will be connected to the through traffic lanes by gradually diverging ramps or access roads. Direct left turns will have to be made on surface cross streets. Where cross traffic is heavy enough to justify the elimination of direct left turns and space is available at reasonable cost, the conventional cloverleaf will be used. Further development of the grade separation with interchange leads to rotaries with two or more bridges to carry through traffic over or under it and to various ingenious arrangements of one-way roads, usually with two or more bridges, which provide paths for the major traffic movements in the general direction of their destination instead of the 270-degree turn of the inner loop of a cloverleaf. Greater use of the three-level grade separations to accommodate some of these direct connections also may be expected." [3]

LANDSCAPE DESIGN

All valuable and irreplaceable landscape features should be preserved; needless damage to trees and other growth and to lake and waterway shores should be avoided. Unnecessary construction scars in the form of borrow pits, for example, should also be avoided, unless they are later obliterated by the regrading of the areas in question. Topsoil is valuable; it should be stripped and stored and thus made available for use after the slopes and other areas to be planted are graded.

Proper planting of the expressway is desirable for many reasons, one being economy of maintenance. The appropriate planting of slopes will prevent erosion; the intelligent use of shrubs and trees will often retard the formation of snow drifts on the pavement. Appropriate embellishment, through planting the park strips on each side of the pavement, will tend to make the project more valuable for those who use it and more attractive for those who live along the adjacent border lands; higher land values will likely obtain on abutting properties, particularly where they are residential.

The following quotation, from a recent report entitled "Interregional Highways," published by the U. S. Public Roads Administration, indicates that the preservation of the amenities and the creation of new ones are worthy of the attention of the engineer. "Highway design, in the broadest sense, rests upon landscape principles as well as upon the more commonly recognized engineering principles of alignment, profile, grade cross-section, roadway and

[3] Joseph Barnett, *op. cit.*

right-of-way width, drainage, and structural strength and durability. A balanced agreement with the two sets of principles characterizes the best design. . . . If engineering principles require a certain monotony of smoothness and attention-lulling security in the roadway design, the appropriate application of landscape principles can relieve the monotony and promote the safety of traffic by reawakening the interest and attention of drivers. . . . All these things may be done in complete consistency with the utilitarian functions of the expressways. And, so treated, these new arterial ways may be made—not the unsightly and obstructive gashes feared by some—but rather elongated parks bringing to the inner city a welcome addition of beauty, grace, and green open space."

It is the writer's firm conviction that almost every element introduced into the design of motorways in the interest of securing beauty, may be resolved into factors which, in one way or another, result in a measure of efficiency and economy. Artistic design in all areas is essential to success in the well-rounded development of our cities and the regions about them.

30 THE DESIGN OF HIGHWAY INTERSECTIONS

BY R. H. BALDOCK

HIGHWAY accident records disclose that roadway intersections at grade are the most potent factor in highway accidents. It is obvious that, when two streams of traffic cross, there is a potential hazard and, based upon the law of averages and in relation to the traffic involved, a certain number of accidents can be expected. This is further complicated, particularly in the urban areas, by the frequency of pedestrian crossings and the presence of cyclists mingling with the cross streams of motor traffic.

When the volume of traffic reaches certain proportions, various measures must be taken to alleviate the conditions. In view of the high cost of the separation of opposing traffic streams by grade-separation structures, it is reasonable to assume that, by and large, all but a relatively small number of cross roads will remain at grade.

In general, highway intersections can be grouped in five broad classes as follows:

1. Minor intersections at grade;
2. Intersections at grade with traffic-signal control;
3. Intersections at grade with channelized traffic lanes and with or without traffic-signal control or speed-change lanes;
4. Intersections at grade providing rotary movement for traffic interchange;
5. Intersections providing for separation of opposing traffic streams by grade-separation structures with or without connecting ramps.

One of the intersecting highways usually carries heavier traffic than the other. We will define such highway as the "preference" highway; the other, as the "non-preference" highway. Since few intersecting highways have grade-separation structures, our major problem is that of highways intersecting at grade. Many of them are minor in importance, while others carry large traffic volumes.

It is difficult to cover a highly involved subject such as highway intersections in a discussion of this length, and in consequence only the broad general principles can be touched upon. The correct solution of the many problems presented involves a mass of detail. No two intersections are exactly alike, and each requires special study. This discussion will merely touch upon the basic features of geometric design such as sight distance, grades, alignment, and

placement of signs as affect the design of an intersectional area; likewise, space permits but limited consideration of such important phases as the assumed design speeds of each highway at the intersection, the dimensions of the assumed design vehicles, and the driving characteristics of the average operator.

Before any improvement is made at a highway intersection, a traffic survey should be conducted to determine the type and density of the traffic on both intersecting roads, the volume of traffic constituting each of the turning movements, the alignment and grade of intersecting roads, and the angle of intersection; likewise, the physical conditions at the crossing, such as topography and culture which limit sight distance and which directly bear upon costs of construction and costs of right of way, are pertinent factors in choosing the type of intersectional design. An adequate design should provide accommodation for the type of vehicles likely to use the highway. The dimensions of maximum-sized vehicles using the intersection and the speed required for the traffic interchange are likewise determining factors in the intersectional design. It is not always feasible to design for the occasional passage of extremely large vehicles when it would materially increase the cost.

MINOR INTERSECTIONS

Most of the intersections in the highway network of this country fall in the category of minor intersections at grade. In general, traffic on one or both intersecting roads is low in density. As a rule, the intersection is at right angles or nearly so. Intersections forming flat angles present a positive hazard because of the necessity for the driver to look over his shoulder to obtain a view of traffic approaching on the other road. Inasmuch as this requires some effort, many drivers fail to do it and collisions result.

While available funds limit to a major extent the corrective measures requisite to improve materially such conditions, a few of them will be listed:

(a) *Through Roads.* It is obviously hazardous to permit traffic to move through intersections at grade totally uncontrolled. The selection of the preference highway as a "through" highway is a decided improvement; all traffic entering upon or crossing the preference highway must come to a full stop and delay entering or crossing until safe clearance is assured. The stop sign should be located near the point where it is desired that vehicles come to a stop. The stop should be close enough to the intersecting highway to permit as unrestricted a view as possible but far enough back to avoid conflict with vehicles turning into the side road. An ad-

vance warning sign such as "Prepare to Stop" should be placed on the non-preference road sufficiently in advance of the point of stopping to permit vehicles to decelerate before reaching the stopping point.

An advance caution sign should, under certain conditions, be placed on the preference road sufficiently in advance of the intersection to permit the operator of the vehicle to stop if necessary. When the intersection is clearly visible for a long distance and the speed on the preference highway is not too great, advance warning signs are usually omitted. The distance from the advance warning sign to a point just clear of the intersecting highway should be at least equal to the stopping distance of the approaching vehicle.

The stopping distance is the sum of the distance traveled by the vehicle during the reaction time of the operator and the distance traveled during the braking time of the vehicle. Perception time is that time required by the average operator to size up a situation, or, in this case, to read and identify the sign or to see the intersection ahead; so, apprised either by the advance warning sign or by the view of the cross road, the driver on the preference road further observes the intersection provided no obstruction limits vision. If no vehicles are in sight, speed may be slackened only slightly, but the operator should be on the alert. On the other hand, if the vision is obstructed, the prudent driver materially slackens speed when he sees the advance warning sign so that an emergency stop can be made, if necessary, to avoid collision. Impaired sight distance at intersections warrants speed-control signs, to be discussed presently.

The driver on the non-preference road, on perceiving the advance warning sign, should slacken speed and prepare to stop, regardless of sight conditions. Since the perception time should not require any travel distance beyond the advance warning sign (assuming the lettering is such that it can be read before the sign is reached), we need only consider reaction time. Reaction time is defined as the time interval required, after perception, for the operator to start braking the vehicle. Tests indicate this varies between one-half and one second. Most investigators have used a safe value of one second.

The distance traveled during the reaction time and the braking time is a function of the speed of the vehicle before braking starts. Assuming all vehicles approaching the intersection are traveling at the assumed design speed of the highway, the posting distances for caution or advance warning signs are as given in the table which follows. Since observations on many highways show that the average

vehicle is traveling at only 0.7 of the assumed design speed of the highway, an additional factor of safety is introduced.

Posting distances for caution signs are calculated as follows:

Highway design speed (V), m.p.h.	30	40	50	60	70
Reaction distance (1.47 V), feet	44	59	73	88	103
Braking distance (0.083 V^2), feet	75	133	208	300	408
Calculated stopping distance, feet	119	192	281	388	511
Suggested posting distance, feet	100	200	300	400	500

The deceleration rate of the braked vehicle is assumed as 12.9 miles per hour per second which corresponds to a friction factor of 0.4, a friction factor readily available on almost all surfaces except when covered by ice. A more detailed discussion of design speed with relation to stopping distance is given in the brochure of the American Association of State Highway Officials entitled "A Policy on Sight Distance for Highways."

Occasionally the driver on a non-preference road does not stop the vehicle; experience indicates, however, that in such a state as Oregon, where "through highways" have been used for many years, this is a rare occurrence. It is, however, certain that the "through highway" principle does not relieve either motorist from exercising due caution and prudence.

(b) *Speed Zones.* Attempts have been made in many states to zone highways in relation to design speeds based upon sight distance and other features of geometric design. This appears to be a reasonable approach to a perplexing problem, and it is believed that it will finally be universally adopted. With proper enforcement, the accident rate should materially decrease.

Speed zones are particularly needed at intersections with impaired sight distance. The ordinary "slow" signs which are usually placed near such intersections are not adequate to meet many situations and are not properly observed by many motorists. Speed zones at intersections can be regulated by traffic-control signs which will be discussed under the heading of "Intersections at Grade with Traffic Signal Control."

(c) *Flared Intersections.* When the paved area on the traveled way is not widened on either highway at an intersection, it is impossible to make some of the turning movements without encroaching upon the opposing traffic lane. On the contrary, the use of large "Y" intersections without provision for an acceleration or speed-change lane to enter the preference highway has the disadvantage of requiring a stop on an acute angle, thereby limiting the operator's vision. As a rule, it is better to flare an intersection by widening

the paved area on both roads so that the turning movements can take place without encroachment on the opposing lane. In general, the curves should be spiraled, or at least three-centered, and have radii of sufficient length to permit a turning movement of the largest vehicle which may use the intersection. The length of radii of curves is also in direct proportion to the desired speed of the turning movement. On pages 10-27 of the brochure published by the American Association of State Highway Officials entitled "A Policy on Intersections at Grade," detailed information with reference to this problem is given.

INTERSECTIONS AT GRADE WITH TRAFFIC SIGNAL CONTROL

(a) *Flashing Beacons.* When the traffic on intersecting highways increases, warning flashing beacon signals are often installed. Such signals continually flash the amber caution color to the preference highway and the red stop color to the non-preference highway. Such signals thus only partially control intersectional traffic, but caution the operator on the preference highway of the presence of an important intersection ahead. These protective devices are quite effective provided they are not installed indiscriminately. Too many "blinker lights" cause the motorist on the preference highway to disregard them. When they are placed at particularly hazardous intersections, a fair degree of observance is secured.

(b) *Traffic-Control Signals.* When the traffic on the intersecting highways reaches the point wherein it becomes difficult for the vehicles on the non-preference highway to enter into or cross through the preference highway, further control becomes necessary.

Traffic-signal control is familiar to all motorists in this country. Two general types of signal control are used: the fixed-time signals and the traffic-actuated type. There are several variations in both. Progressive traffic signals synchronized to a selected speed for use on long sections of urban boulevards carrying heavy traffic have been found quite effective. Traffic readily accommodates itself to moving at a uniform speed along the boulevard without stopping, while in between such vehicles cross traffic moves without interference.

INTERSECTIONS AT GRADE WITH CHANNELIZED LANES

The use of wide, flared, paved intersections may cause confusion, particularly as the traffic increases. The correct position for the vehicles for each of the various turning movements must be well defined; for instance, the presence of a vehicle in the right lane

when the driver intends to execute a left-turning movement snarls all the traffic at the intersection. Painted lanes are an aid, particularly when the words "left-turn lane" or "right-turn lane" are painted on the pavement in the proper location.

A better way is to install traffic dividers advising traffic of the proper lanes by means of large overhanging signs directly over the painted traffic lanes before the physical traffic dividers are encountered. The traffic dividers widen into islands at certain "dead zones" in the paved area. These serve as strategic locations for the installation of information and direction signs and also as a refuge for pedestrians crossing the intersection. A wide, paved intersection without islands is a deathtrap for pedestrians. It is impossible to watch out for traffic in all directions. The use of traffic islands requires the pedestrian to watch in one direction only, since the traffic movements are made by following one-direction routes.

Left-turn movements at highway intersections at grade are the source of many traffic accidents. Provision for a left-turn lane or "slot" has been found to give excellent results. The left-turn lane should be built in the preference highway and can be used in either a two- or a four-lane road. The opposing lanes are spread apart at the intersection, and the resultant segment serves as a haven of refuge for the vehicle desiring to make a left-turning movement. The use of a pavement of a contrasting color and texture is preferable, and an overhead lighted sign is recommended to inform the motor-vehicle operator of the presence of the left-turn lane. Curbs or other barrier devices should be used to mark the "slot" for the left-turn lane. The driver can wait in the lane without the hazard of conflict with traffic until the intersection is clear. In particular, the mental hazard of a rear-end collision in fast-moving traffic is removed. Many times the fear of a rear-end collision causes drivers to take chances in completing a left-turn maneuver in the face of opposing traffic, and accident records disclose that accidents as a result thereof are increasing. The building of left-turn slots eliminates this hazard. The public soon grasps the significance of the plan and readily makes use of the improved and safer facility.

By means of speed-change lanes adjacent to the regular traffic lanes, traffic may decelerate to turn off either highway or accelerate to join the traffic streams on either highway without stopping. The change in speed required is a function of the design of the curves at the intersection. If possible, the radii of the curves should be such as to permit speeds not less than 40 per cent of the design speed of the preference road. Cross traffic may require traffic-signal control. In the case of "T" intersections where the preference road

is a four-lane highway and where traffic signal control is used, the outer lane of the four-lane highway can be separated from the inner lane by a traffic divider. Green arrow lights can then be installed, permitting traffic to proceed on the outer lane at all times, regardless of the signal-control operation. The inner lane should be marked by overhead signs for left-turn movements; the outer lane, for through movements. This type of channelization materially expedites movements at "T" intersections. Many times it is found to be an advantage to widen a two-lane preference road to a four-lane facility at an important intersection to facilitate turning movements and minimize accidents. Channelized intersections can be used to advantage when the traffic is not great enough to justify either traffic-signal control or speed-change lanes. In even minor intersections, island dividers to separate traffic can be used to great advantage.

ROTARY INTERCHANGE

Another type of intersectional design between the types previously outlined and grade-separation structures is known as a rotary intersection. Such intersections have been referred to as "traffic circles." This, however, is a misnomer, because the design of the central island is usually of various shapes such as rounded squares, diamonds, ovals, polygons, and other combinations of unsymmetrical shapes.

Essentially a rotary is a one-way, closed-circuit road in which all traffic converging on a given point is directed and from which traffic emerges into the radial roadways. It might be described as a series of one-way roads joined smoothly to form a continuous one-way road connecting entrances to and exits from several roadways.

The path followed by a motor vehicle through a rotary intersection is a counter-clockwise, one-way movement around a central island. The crossing of vehicles is accomplished at small angles, resulting in a weaving type of movement. There has been a definite trend toward larger-dimension rotary intersections affording easier curves and permitting higher travel speeds. The desirability of built-in, channelized control to induce the traffic to follow a desired route is generally recognized. The earlier designs were symmetrical in shape, but the symmetrical designs did not accommodate normal motor-vehicle movement, resulting in the presence of sections of "dead" pavement with a resultant constriction of traffic at other points. Years of study have indicated a choice of design based upon actual traffic behavior so that the vehicle movements are simple and natural.

The use of grade-separation structures carrying the preference traffic built over a rotary with connecting ramps often proves a desirable design of traffic interchange. In general, rotaries require so much land and slow down traffic to such an extent that grade-separation structures with connecting ramps are to be preferred.

GRADE-SEPARATION STRUCTURES WITH CONNECTING RAMPS

It is obvious to anyone that intersectional accidents can be eliminated by separating the grades of the cross streams of traffic. If the mere separation of cross streams of traffic would accommodate all the traffic movements, the problem would be quite simple and the cost relatively nominal; however, it is usually necessary to effect an interchange of traffic between the cross highways, which sometimes makes a very difficult and costly problem, particularly when several highways intersect near the same place.

It is certain that the volume of traffic that can pass through an intersection will approach the total capacity of the two intersecting highways through the provision of roadways at different levels so as to enable both through streams of traffic to flow without interruption.

When appropriate connecting roadways for the interchange of traffic between the intersecting separated highways are built in such manner as to eliminate cross-traffic movements, the ideal situation is realized. Separations can be made by passing the preference highway either under or over the non-preference road.

The most conventional type of grade separation that has been used is either the full or partial cloverleaf design. There is, however, a fundamental defect in the cloverleaf principle in that it confuses motorists wishing to make proper connection with the intersecting highway. All left-turn movements are made by two successive right-turn movements. This is quite confusing to a driver not acquainted with the cloverleaf type of traffic interchange in general and with the case at hand in particular.

A preferable type of grade-separation design is the one which has been designated a "directional interchange" which is an intersection involving more than one grade separation structure at more than two levels of traffic in which directional interchanges are provided so that the procedure for the desired turning maneuver is natural and obvious. When the destination is to the left, the interchange facility turns to the left, passing either under or over the highway upon which the vehicle has been traveling. It is, of course, necessary to enter the correct interchange lane before reaching the point of diversion, and overhead lighted signs should be placed over

the correct lane ahead of the point of diversion indicating the route number and the name of the next important town to which the interchange lane leads. Directional interchange facilities generally provide three or four traffic levels. The warrant for the expenditure of the funds required to eliminate cross highway traffic at grade is largely a function of the delay and expense suffered by traffic. The evaluation of the benefits from the saving in time and saving in motor-vehicle operating costs is worthy of special study and investigation.

CONCLUSION

Proper design of highway intersections is one of the more important phases of highway engineering. The solution of each problem, based upon the best design within the permissible expenditure of funds, requires a thorough knowledge of the principles of geometric design and of traffic behavior. When improvements are made at the intersections based upon the solutions of the many and varied problems involved, a major step will be taken toward the minimizing of highway accidents; likewise, progress will be made in expediting traffic flow, which is, after all, the main objective of the highway engineer.

31 THE HIGHWAY AS A PARKWAY

BY H. J. NEALE

OLD Mother Nature is predominantly responsible for the charm that makes parkways so universally appreciated. Nature can do the same for highways when given equal opportunities.

The first parkways were designed to serve as a pleasant means of access to or between parks in cities or metropolitan areas. These parkways have always been limited to non-commercial traffic. The earliest parkway design had a single broad drive, well supported by turf and shrubs and shaded by trees. In some places, two driveways are provided, separated by a broad grass median strip, which allow for greater embellishment by trees and shrubs, and in some cases paths are provided for pedestrians and bicyclists, as well as the equestrian. In so far as possible, sites selected for parkways usually traverse areas of distinctly natural beauty, as along a lake or river. Today we may well define a parkway as "a limited-access highway open only to non-commercial traffic, where abutting property owners are without privilege of light, air and access."

Obviously the limited-access highway, the freeway, the divided highway, the naturally developed roadsides, waysides, or roadside parks, parking areas commanding scenic vistas, and the many other comforts that are being provided in modern highway design, have been influenced by the popularity of the relatively few parkways in our country.

Completely developed parkways exemplify a pleasing combination of four basic qualities—Utility, Safety, Beauty, and Economy. In the first place, the purpose or utility provided in parkway design is of a recreational nature, as it provides motorists, as well as pedestrians, with opportunities to travel in an atmosphere of natural beauty. From a safety standpoint, the parkway was never intended to be a speedway, nor to serve as an ordinary thoroughfare. Since it is designed primarily for recreational traffic, safety features are easily controlled. Inasmuch as parkway locations are usually selected to traverse areas of natural beauty, the driveways must be designed in such a manner as to accentuate these features, and at the same time conserve and protect the natural beauty of the area. In many cases it has been possible to reduce construction scars to a minimum, or at least to replant them so they harmonize with surroundings. A combination of appropriate design and

selection of self-supporting plant materials promotes economical maintenance and provides enduring beauty.

For nearly three-quarters of a century, parkway designers and officials have been learning the long, hard way. Each change in type of vehicular transportation has necessitated a change in design of park roads and parkways. The early horse-and-buggy-day parkways had speed limits under 15 miles per hour, being designed primarily for pleasure driving. The automobile brought about the need for radical changes in design and construction. In order to provide proper alignment and grade, wider rights of way were necessary. Wide rights of way serve in a dual capacity, as they not only allow for more adequate handling of traffic but make it possible to protect and preserve more natural vegetation.

From the original conception—merely to connect parks—a much broader use was promoted for planners of suburbs in metropolitan areas, such as Westchester County, Long Island, and Connecticut. Parkways there serve also as highways or throughways. In later years, the original idea of connecting parks was greatly augmented by the National Park Service in developing the Skyline Drive and Blue Ridge Parkway, connecting the Shenandoah National Park and the Great Smokies of North Carolina—a truly magnificent parkway traversing the Blue Ridge Mountains of Virginia. Other outstanding examples are the Colonial Parkway, connecting Jamestown and Yorktown, and the Natchez Trace.

These major parkways, being designed for normal automobile speeds rather than the 15 miles per hour for horse and buggy, necessitated the adoption of design speeds nearer those of highway requirements. However, the basic qualities of Safety and Beauty were admirably integrated into their design and construction. Sweeping, spiraled curves, leading the motorist through picturesque scenery, supplant the axiomatic "straight line as the shortest distance between two points," so prevalent in highway design. Where rugged topography is encountered, it is necessary to increase greatly horizontal curvature, as well as gradients, over highway standards, but this does not have the same effect on recreational traffic as it does on the fast and heavy traffic of the highway.

Parkway design has thus progressed from horse-and-buggy standards to the point where it meets the requirements of the most modern highway. At the same time, commercial vehicles, heavy trucks and trailers, are excluded, in order that the light vehicular traffic may travel with more safety—with less driver-fatigue, which on the highway is so largely accentuated by conflict with commercial vehicles. Fatigue is further lessened by the naturalistically developed

roadsides, which present an ever-changing aura of natural colors, lights and shadows, cool refreshing shade, and vistas inviting pause. The parkway also furnishes an environment of kindred souls (barring the "road hog") appreciative of the opportunity to travel in the luxury of nature. Thus the parkway, started primarily as a recreational thoroughfare replete with trees and turf, has maintained these original precepts, and at the same time has adjusted itself to modernization.

Fifteen years after the turn of the century the country road was the horse-and-buggy parkway in most rural areas. The automobile was fast becoming more commonplace and increasingly essential to the economic and social development of our nation. Doctors, lawyers, farmers, and merchants of all trades soon accepted the motor vehicle as a business necessity. The several states were then called upon to build all-year, all-weather roads. The common slogan was "get the people out of the mud." Some states issued long-term bonds to accomplish this feat more rapidly, while others went on the pay-as-you-go basis. It was but natural that the urge to cover so many thousands of miles with ribbons of asphalt, concrete, or stable material, with a minimum expenditure, made it essential to limit the expenditures to the roadway and largely disregard the roadsides. This condition prevailed for several years, or until more consideration was given to growing maintenance burdens indicating the necessity for effecting economies in design for the entire right of way. It took but casual observation to see that a large portion of these maintenance funds was being used to rebuild washed-out shoulders and reconstruct scouring ditches caused in many cases by severe roadside slope erosion.

At the same time, many people accustomed to the beauties of the country road began to demand more attention to conservation of vegetation along these newer highways. Where conservation measures were not practicable, rehabilitation of the raw, unsightly, dusty, erodible cut and fill slopes was demanded. This introduction of landscape techniques into highway engineering was referred to at the time as the "pansy-planting era." People who were still traveling on mud roads resented the use of highway funds for turfing, planting of ground covers, or other roadside landscaping features, as they failed to consider the economic values accruing from vegetated roadsides. The landscape program was thus greatly retarded.

In 1930 the American Association of State Highway Officials and the Highway Research Board of the National Research Council appointed a Joint Committee on Roadside Development. The objectives of this Joint Committee were to plan and conduct research

in all phases of roadside design, construction, and maintenance that would more fully promote the essential qualities of complete highway engineering—Utility, Safety, Beauty, and Economy. Not only did this Committee study the landscape, construction, and maintenance elements, but took into consideration the off-highway aspects of zoning, border control, and land-use measures. One of the chief objectives was to fit the highway more appropriately into the general landscape of the area traversed.

This Joint Committee continued its deliberations until 1940 when it was dissolved, and all problems involving administrative matters were assigned to the Committee on Roadside Development of the American Association of State Highway Officials, while the Committee on Roadside Development of the Highway Research Board was delegated to handle the research problems.

The following excerpts from the 1943 Report of the latter Committee indicate the extent of the research covered in thirteen years and its relation to highway development:

"Today, as never before, our horizons are limitless. War has encompassed the world. While we are working for early ending of hostilities, we are planning for complete, world-wide, and permanent peace. Plans and preparation to take care of postwar problems and activities are now in the making, in advance of the time they will be needed; each project so designed that it will be complete in all details. One of the major parts of this postwar program will be highways planned for both permanency and utility, or what might be termed COMPLETE HIGHWAYS.

"The Committee on Roadside Development believes that the design of highways should be built-around the four basic qualities of utility, safety, beauty, and economy. Research and past experience have demonstrated that proven landscape or roadside development practices contribute to each of these qualities. This year we are focusing attention on basic principles of landscape design and practice which should be incorporated in postwar plans for all highway construction. The many interrelated factors to be considered in the building of a complete highway may be combined under four basic requirements.

"UTILITY is most important, for unless a highway is serving completely in a useful capacity, its value is limited. In the broader sense, utility means service, and as such includes provision for the handling of all types of traffic, with adequate safety-turnouts, waysides, parking facilities for school and commercial buses, service areas for the distribution of mail, gasoline, milk, and farm products, as well as elements that result in the enhancement of land values.

Complete highway service and enhanced land values go together.

"SAFETY means orderly movement of vehicular and pedestrian traffic. The COMPLETE HIGHWAY design should eliminate present and potential traffic hazards by keeping sight distance open on curves and at intersections, by flattening slopes so that traffic may leave the traveled way quickly and safely in emergencies, and by preventing erosion from forming gullies or deepening ditches into veritable traps for motor vehicles. These and other hazards may be avoided by demonstrated roadside development methods.

"BEAUTY, an essential part of the COMPLETE HIGHWAY, requires the harmonious integration of engineering, architectural, and landscape techniques. Conservation of stream shores, fine trees, weathered rock ledges, and similar natural features is essential to the attainment of beauty in the finished highway. A well-located highway with a streamlined, erosion-proof cross-section, and with well-designed structures in relation, has pleasing and long-lasting qualities which appeal to both the land owner and the motoring public.

"ECONOMY is the quality of providing maximum vehicular and driver service combined with safe design and pleasing appearance, at relatively low construction and maintenance costs. Since the unit costs of annual highway maintenance may be decreased through the integration of the basic principles of landscape design and practice, it is obvious that developed roadsides are an economy.

"In referring to the COMPLETE HIGHWAY, attention is not focused on the superhighway, the freeway, or the parkway, for the same basic qualities should be integrated into the design and construction of every road, whether it be local, county, state, interregional, or international."

Let us briefly evaluate the four qualities as they pertain to the parkway and the highway.

The utility, or use of a parkway, is obviously recreational, serving to furnish outdoor facilities for the thousands of people living in congested areas. The recreation facilities may be of an active nature, such as playgrounds, bathing beaches, baseball and football fields, and the many and varied outdoor recreational activities. Or, on the other hand, they may be of the passive nature, with quiet nooks for the person who loves to read in the open, or shady places where people can rest and relax, overlooking fields of wild flowers bordered by towering virgin trees, or vistas of majestic splendor. Care is most essential in the selection of such areas, in order that maximum recreational services may be provided.

Highway locations are, in a large measure, governed by the

communities they are to serve. It is not always essential that a highway be located on the shortest line between these communities, particularly when it is possible to select a moderately winding alignment that will traverse areas of natural beauty. Where commercial interests are of paramount importance, selective routes may be provided to facilitate trucking movements on the one hand and furnish recreational interests on the other. A careful analysis of all factors involved furnishes the criterion on which to select the route that will furnish the greatest service. In many states, public utility interests must be given consideration in determining the necessary right of way widths. Although pole lines are unsightly at best, this is a public service that cannot be ignored. If they must be located on a highway, adequate rights of way should be provided to enable them to be screened from view as much as possible. Utility pole lines and roadside trees can survive harmoniously on the same highway under proper design.

The urge to speed up traffic movement has undoubtedly contributed to the appalling death and accident toll on the highways during the last decade or more. It is generally conceded that unsightly automobile graveyards, startling billboard displays, sign-infested roadside stands, eroding road slopes, and other objects of distraction have contributed to the accident toll. On the other hand, the parkway record is relatively unblemished by accidents. A comparison of these records indicates a preponderance of evidence that roadside eyesores are contributing factors in the accident toll. Trees, shrubs, ground covers and turf tend to reduce driver-fatigue by not only screening eyesores but, in a larger way, by producing a parkway atmosphere. The restful shade from overhanging trees reduces pavement glare. Roadside trees may aid in outlining both horizontal and vertical curves when planted formally, and, in a measure, the same may be said of informal planting. Traffic signs, so essential to safety, are given more attention or target values when backed by close-growing trees or shrubs. Roadside parks, waysides, and informal parking areas add safety by furnishing ideal opportunities for rest along the highway. Picnic tables at vantage points furnish an additional highway safety service. Long, wide areas adjoining shoulders offer ideal truck parking places. Wherever these areas are being constantly used, drinking water and toilet facilities add to the comfort of the truck drivers. The weary, tired truck driver is definitely a menace to traffic. The modern, streamlined cross-section, with flat cut and fill slopes, broad shoulders and swaled gutters, offers ideal opportunities for escape from collision or accidental run-off from the roadway.

The attractiveness of towering or arching trees, masses of shrubs, fields of wild flowers, and greensward, together with graceful curves of the winding road, contribute beauty to any highway. Whether these are artificial or natural, the effect on the motorist is pleasing and restful, on the crowded highway as well as on the parkway. This effect cannot be obtained on narrow, confined rights of way. Until the highway engineers acquire wide rights of way, they cannot expect to produce the parkway atmosphere. Trees and flowering shrubs must have room to expand naturally—must have room for root spread to nourish them. Parkway roadsides furnish these features in nearly all cases, while in the past these areas have been limited on highways. Much of this beauty can be promoted by careful selection of location, combined with conservation processes. Additional right of way should be acquired along rivers or bodies of water, through heavily wooded areas, at points where vistas can be developed or where picturesque formations prevail, or where large masses of native flowering shrubs furnish lasting beauty on any highway or parkway. Many of these areas are susceptible to development as waysides.

Waysides must be designed in such a manner as to provide for minimum maintenance. These areas should be kept relatively open in order to eliminate the necessity of constant policing. Roadside springs should be captured and protected from contamination, and should be inspected periodically for their purity. The design of shelters, fireplaces, wading pools, fishing ponds, and other such areas should be so handled as to make them available for the public at all times, and not require constant clean-up and policing.

The enormous investments that have been made in highways and parkways during the last quarter of a century are neither an asset or a liability to the sponsoring agency. These should be paying their own way, the same as any other public expenditure. They are based on assumed longevity. Added expenditure that will prolong their longevity or reduce their maintenance costs may be an economy. Eroding slopes, scouring ditches, unnecessary traffic signs, the slowing down of traffic below legal speeds, soft or otherwise hazardous shoulders that require constant shaping, and the many other so-called minor maintenance elements, unless given prompt and continued maintenance, impair the life expectancy of the roadway and increase the over-all cost. Any measure taken to reduce upkeep and produce added longevity is an economic investment. The roadway may be 20 to 72 feet or more in width, but it requires broad, stable shoulders adequate for any emergency, a drainage-way adequate to keep the roadway well drained at all

times, and sufficient roadside width to produce natural vegetation and not require constant attention. Roadsides should be wide enough to promote a pleasing effect and allow for the screening of unsightly conditions. Highways may also prove to be assets or liabilities to adjoining properties. It is obvious that when a highway promotes residential or commercial development, it is an asset to the community; whereas highway locations traversing ideal agricultural areas may be draining and lowering ground water, or promoting erosion on farm lands, and thus be a liability. A careful analysis of soil conditions, a thorough hydrological survey, combined with conservation processes, will materially help to enhance, rather than detract, land values. The selection of vegetation that does not require constant mowing, pruning, spraying, or other care, is of vital economic importance. The selection of native plant material instead of importations of exotic material promotes more harmonious and naturalistic roadside conditions. The modern streamlined cross-sections susceptible to economic development of turf allows for machine mowing instead of hand operations, adds safety to the roadsides, reduces slides, and prevents excessive snow drifting. The selection and location of material on the roadsides that will serve as snow fences can be important in many areas.

Highways of the future can compare favorably with parkways, wherever right of way is acquired sufficient to develop naturalistic landscape settings. Where the right of way is limited, the adjoining land owners can develop the parkway atmosphere by cooperative planting of trees and appropriate shrubs, by setting back their buildings, and by cutting brush and trees to open pleasing vistas. Commercial establishments can be made attractive roadside features, provided they are set back from the road far enough to allow for naturalistic plantings and are not overburdened with unnecessary signs. Through the medium of the Interregional Highway System, people of all states will become educated in the values accruing from the complete highway, where every consideration will be given to the integration of the four basic qualities of Utility, Safety, Beauty, and Economy, on the entire right of way.

32 HIGHWAY ENGINEERING

BY L. I. HEWES

HIGHWAY engineering essentially is the application of engineering principles to the construction and operation of highways. In the United States, it is only about fifty years old. Early in the last century, however, the National Pike westward from Cumberland, Maryland was surveyed and constructed, as were a multitude of turnpikes of more local character. Notable among these was the so-called North-Western Turnpike from Winchester, Virginia, to Parkersburg, West Virginia, located by Claudius Crozet and completed in 1848. With these and other minor exceptions, there was no extensive highway engineering in this country prior to the Massachusetts and New Jersey state highway work which was well under way by 1895. Since then, the expediture for improved highways under engineering control has exceeded 40 billion dollars. Highway engineering in the United States thus actually stems from the state highway departments. The initial development by Massachusetts and New Jersey was followed by New York and other northeastern states, and by 1912 California had taken the lead in the Far West.

Highway engineering, however, had been practiced in England and France for many years by such men as McAdam and Trésaguet.[1] Considerable information about English practice is attractively presented in Sir Henry Parnell's *A Treatise on Roads,* published in London in 1833. It describes the work of McAdam and presents many principles applicable today. Another pioneer highway engineer was Thomas Telford, a contemporary of McAdam; he developed foundation courses of large broken stone.[2] It is to be noted here that Trésaguet preceded both Telford and McAdam, and thus is the father of modern highway construction.

Modern highway engineering at first borrowed considerably from the developed railroad engineering practices. It is noteworthy, however, that its very beginning in America and England preceded

[1] John Louden McAdam, 1756-1836, built the first "macadam" roads in London in 1817, and greatly developed ideas of broken-stone roads. He was in America during our Revolution. Pierre-Marie-Jérôme Trésaguet, 1716-1796, made it possible for Napoleon to build the French highways.

[2] Thomas Telford, 1757-1834. Founded the Institution of Civil Engineers in England.

the beginning of the era of railroad construction. In the century before 1895, rural highways in general were under the control of county or town authorities who used practically no engineering.

LOCATION

Except for the location of certain historic roads and other minor ones, highway location on instrument lines has been developed largely by the state highway departments and the U. S. Bureau of Public Roads. Until motor traffic began to exert an increasing influence, instrument locations were mostly within existing rights of way. They accomplished the layout of smooth curvature and enabled control of the profile for new construction. They were a vast improvement on previous practice. For about twenty years, however, the alignment and grade were conditioned wholly by horse-drawn traffic. Consequently, in spite of good engineering control, there resulted many sharp curves and steep grades and their combinations. Slowly the influence of motor-driven traffic made itself felt. By 1920, all the states had organized state highway departments with good engineering technique. A few counties also had developed good highway engineering organizations. Locations in the areas of less dense population reflected the influence of railroad standards of line and grade. In the more densely populated eastern states, locations suffered because of limitations of existing rights of way. In the public land areas of the Middle West, there often was an unfortunate tendency to follow section lines and turn right angles at section and quarter-section corners. During the past twenty-five years, the demands of fast motor traffic have compelled increasing attention to much better location practice. The modern highway engineer seeks to establish locations by first determining the "control" points and then running the best possible line between them. Often, and particularly in the Far West, control points are mountain passes or rivers and of course termini, which usually are in cities or towns. In the more densely populated eastern states, where geographic controls still are important, there are many other controls determined by the cultural development of the area. In many instances, cultural controls, such as buildings, canals, cemeteries, etc., have exerted an adverse influence on good location. Within the last ten years, there has been a marked tendency to break away from conditions previously accepted as determining factors in highway location and to produce locations of unquestioned merit and of permanent service to traffic.

Because it is recognized that every effort must be applied to the reduction of the large annual death rate from motor vehicle acci-

dents, it follows that highway location must not introduce any hazard in the constructed road. The highway engineer, therefore, must not only avoid sharp curvature, but must see that the located line does not restrict sight distance and create thereby a hazard in driving the highway. Stopping sight distance means distance within which a car may be stopped when the driver sights an obstacle. Since modern highway speeds run up to 60 miles per hour or more, the stopping sight distance must take account of such speeds. Similar considerations require long distances of visibility for motor vehicles to pass slower vehicles moving in the same direction. "Passing sight distances" require very extended stretches of so-called tangent or sections of low curvature.

Considerations of grade become more important as heavy trucks increase. Passenger cars can negotiate fairly steep grades, but motor trucks suffer on grades above 3 or 4 per cent. Since modern traffic includes an ever-increasing percentage of motor trucks (currently, about 20 per cent), it usually is necessary for the engineer to keep the highway grades low. As in the case of horizontal curvature, vertical curvature will restrict sight distances. Consequently, modern highway profiles demand long vertical curves—on important highways, usually a thousand feet or more in length, depending on approach grades. Of course, the combination of curvature and grade must have especial attention.

A special item of modern highway location is to obtain the best possible alignment and grade at the approach to bridges or grade separation structures. The highway location governs the position and design of the structure. The objective is plenty of sight distance approaching the bridge. So approach curvature and grade must not be too abrupt. Such results often require heavy expenditure as when, for example, a highway is in a narrow valley or canyon and must cross a river to obtain easy curvature. In the western canyons, such "tight" situations are especially expensive for smooth-flowing curvature. In modern highway location, the engineer must avoid undue violations of the natural beauty of the countryside. He must pay more attention to landscape effects. The engineer's job consequently becomes more of an art than ever. He must not make large through cuts that will leave raw scars if by more care and patience he can produce a line of comparable standard and avoid them. His judgment of justified expense for improved appearance must be well trained and accurate.

In rocky valleys or canyons especially, the decision of how frequently to bridge the existing stream to avoid unsightly permanent scar on rock cliffs or canyon walls requires much engineering skill.

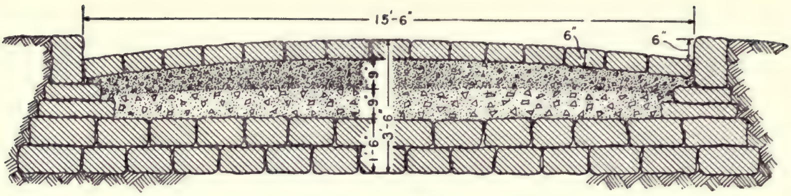
Some situations may compel consideration of the driving of tunnels. Without artificial ventilation, they often may not much exceed a thousand feet in length. Every proposed tunnel must be balanced against possible alternates.

In all highway locations the need for ample width of right of way is becoming constantly more recognized. Whereas rights of way as narrow as 30 feet formerly existed in eastern states, the modern demand is for a right of way of at least 100 feet; and on major four-lane highways, frequently widths of 300 feet are required. Modern engineering practices have developed a marked public appreciation of good locations. Such examples as the Pennsylvania Turnpike and the Merritt Parkway in the East, the Kansas City-St. Louis Highway in the Middle West, and the relocated section of Route 101 in California above Shasta Dam appeal to the modern motor operator as outstanding examples of combined construction and operating economy.

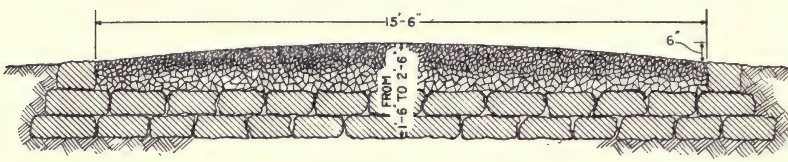
DESIGN

Highway engineering has developed a progressive series of design standards since the first extensive construction began in the late 1890's. Modern design is quite different in respect to the cross section of the highway and in respect to curvature from the early designs. The cross section has progressively increased from 15 feet of "metal" or surfacing to 24 feet for a comparable two-way standard highway. Shoulders that formerly were quite narrow and sometimes merely a part of the inside slope of the ditch are now widened to anywhere from three to ten feet exclusive of the ditch, which is much further from the road.

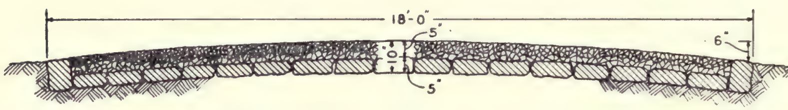
During the past ten years there has been a steady increase in mileage of highways in which a separation strip of variable or constant width is introduced between dual highways. Each such highway is of at least two lanes and designed for independent movement in each direction. For traffic exceeding 3,500 vehicles per day, four-lane highways with a center parked area are without question safer and more pleasant and comfortable to operate than any preceding design. This four-lane design for separated highways is the result of an evolution from a four-lane undivided pavement in which the coming and going traffic was separated merely by a dividing stripe painted on the highway. Stripes were doubled and widened, then painted on a different color background, and then gradually 4-foot and wider separation strips were introduced. The modern separation strip need not be a constant width and gives better landscape effect if the width varies. If the strip is about 4



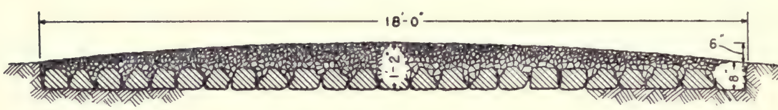
ANCIENT ROMAN 2-LANE MILITARY ROAD.



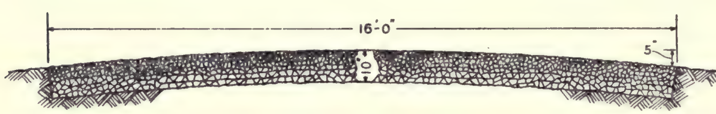
FRENCH ROAD (ROMAN METHOD) PREVIOUS TO 1775.



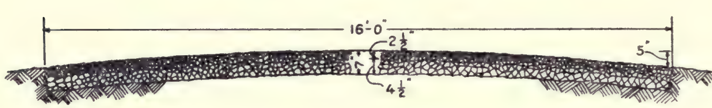
TRÉSAGUET ROAD, FRANCE, 1775 TO 1830.



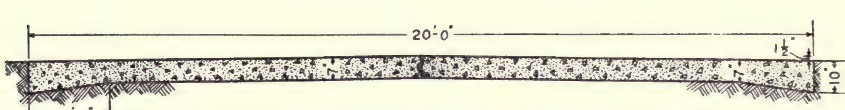
TELFORD ROAD, ENGLAND, 1820.



ORIGINAL MACADAM ROAD, ENGLAND, 1816.



MACADAM ROAD, UNITED STATES, 1900.



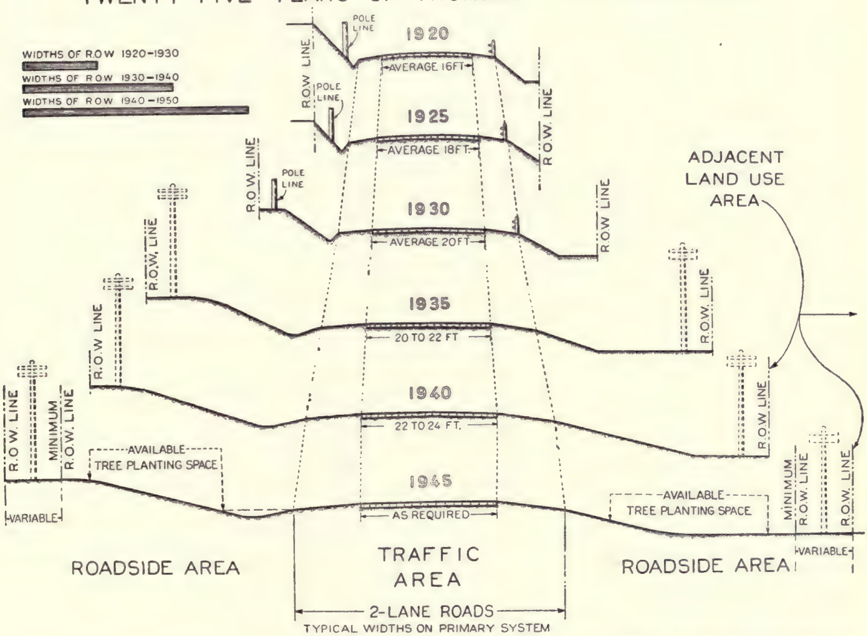
HEAVY-DUTY 2-LANE CONCRETE PAVEMENT, UNITED STATES, 1934.

Cross-Sections of Roads from Ancient to Modern Times

feet or more it generally has sloped curbs and is usually planted to grass or low shrubs.

Another evolution in the design of the cross section is to improve the foundation courses which support the pavement by extending their width across the roadbed into the gutter slope on through cuts or to the fill slope on through fills. It has been found that sub-base courses and base courses are usually required for the best modern pavement design, and that regardless of the type of pavement surface the increased support by a full width sub-base or base is of advantage in reducing maintenance costs and improving surface quality.

TWENTY FIVE YEARS OF HIGHWAY CROSS SECTIONS



COURTESY PUBLIC ROADS ADMINISTRATION

Another improvement in the evolution of the cross section is the introduction of flatter cut and fill slopes and the rounding of all the slope intersections. These changes in design are primarily for better appearance, but they produce a design of less expense for maintenance. The flatter and rounded slopes enable vegetation to recover and extend over the raw slopes, thus preventing erosion. The highway engineer is now accustomed to broader and flatter side ditches or gutters which are in harmony with increased safety and increased sight distance. In areas of heavy precipitation, steeper ditches re-

quire some kind of pavement. Frequently, expensive retaining walls must be built either on the upper or lower slopes of the highway.

There is a great deal of minutiae in modern highway design, especially when highways are built in urban areas or metropolitan zones. There is also need for considerable special designing in steep mountainous locations.

With respect to the alignment and profile, the design has greatly improved with time. Thus the necessity for superelevating the modern pavement for fast motor traffic is quite as imperative for counterbalancing centrifugal force as in the case of railroad curves. Within ten years has come the introduction also of "spiralling" of curves. Spiralling indicates an easement from the straight road to the full curvature by a transition of desirable length in which the curvature constantly increases to the maximum used at the center of the curve. Such transition curves, of course, demand a corresponding gradual superelevation of the outside edge of the pavement to make for smoother driving. It generally is accomplished by "rotation" or raising of the cross section on one side. Special spiral or transition curve tables are now available to the highway engineer, who is accustomed to stake out spirals as a matter of routine. Maximum superelevation for curved sections is limited by slipping where ice forms on the surface during the winter. With no ice hazard, the maximum superelevation used is 1.25 inch per foot. To prevent slippage at slower speeds than the design speeds, optimum superelevation often must be reduced. With the modern objectives of long sight distances for stopping and passing, it usually is not necessary to introduce curvature sharp enough to require that superelevation for the design speed be a hazard for icy conditions. Of course, "tight" situations occur where curvature must change direction rapidly or where an "interchange" is involved when two highways cross. In such instances, careful design of the reverse or "roll over" in superelevation is required.

Of course, in the past fifty years there has been much improvement in the minor details of highway engineering design and construction of miscellaneous structures. Thus, we have better guard or "guide" rails, generally lower and designed to withstand heavy shock. We have safer catch-basin positions and coverage. Cross drains are placed more frequently and with larger waterways. Culvert foundations, both for pipes and concrete boxes, are more carefully prepared and their outlets arranged to prevent concentrated discharge which formerly caused erosion. The American Association of State Highway Officials has adopted standard signs for directing traffic by placenames and distances and also for safe-

guarding highway operation with ample warning against hazard or danger. The Association also has active committees on other highway engineering matters.

Landscaping or improving the highway appearance involves design. As noted, flatter slopes are required for good appearance. Preserving natural growth usually helps the road appearance. Transplanted shrubs and trees and effective sodding of certain areas often improve the pleasing aspect of the highway.

One of the most notable and effective safety devices of modern highway engineering is the separation of grades of railroads and highway and grades of intersecting highways themselves. Under the stimulus of Federal Aid, thousands of railroad grade-crossing eliminations have been made and thousands of other such crossings protected with flashing signals. The separation of intersecting highway traffic streams themselves is more recent and is continually increasing with the increased flow of motor vehicles. One style of complete right-angle highway-grade separation design is the so-called cloverleaf with loops in the four quadrants. The object is to enable traffic always to turn freely to the right. This and similar combinations are known as "traffic interchanges." Unless there is a considerable area permitting large radius curves in the interchange, the cloverleaf design has certain defects. It has definite limitations for large volumes of turning traffic, nor is it warranted unless the traffic flow combination is of recognized minimum volume. It has various modifications such as, for example, a design with from one to three loops, according to the turning movements involved. Traffic interchanges in metropolitan or urban areas tend to become quite complicated. The best thought seems to be to design highway positions to avoid collisions of traffic streams rather than to elaborate and increase expenditure for extricating traffic from the conflict of flow. With still more careful planning, much conflict of traffic may be avoided. Traffic interchange design must still be regarded as evolving or in a transition phase. Cloverleaf design in various stages is perhaps not the final answer. Modern traffic, of course, has inherited the "circle." Here radial roads may be reached by a weaving of the traffic around a circular arc of reasonable radius. A modification is a combination of a circle or oval set across and above a busy highway with ramps and radial connections. This loop interchange also is in an evolutionary period.

There also are various designs for guiding traffic turning movements at grade intersections (channelization), and some of them are very elaborate. There is a risk of confusing drivers by too elaborate design with traffic islands and curve guides. A sound principle

is to design intersections at grade so as to allow traffic to move where it wishes to move and with the minimum of conflicts or collision in the traffic streams. Obviously, solutions of the turning movement and intersection problems that arise with modern traffic require the very best highway engineering practice.

HIGHWAY SYSTEMS

Highway engineering is involved in the setting up of highway systems. The operation is based on traffic information. In the past decade, the nation's flow of traffic has been ascertained. The resulting counts, for the first time, permit intelligent highway classification. Roughly, seven-eighths of all main highway traffic involves the city either as origin or destination. This fact makes for corresponding special attention to the proper layout of highways in and approaching urban areas. Depending on population density and degree of development, through highways between large centers are of corresponding importance. The principle of freeways or highways of limited access is becoming recognized as necessary. Such highways prohibit the entrance and departure of abutting owners except at designated points where turning and crossing movements are concentrated. Such freeways are a great step forward in the interest of traffic safety. Their development, especially in metropolitan zones, undoubtedly will be great. There is now under way the design of a system of 40,000 miles of interstate highways connecting our principal cities. This system will have extensive freeway mileage.

The almost complete substitution of automobiles and trucks for horse-drawn vehicles has resulted in disadvantage to those communities that are without modern highway access. This is reflected in demand for better highway engineering in all rural communities. The Federal government has recently recognized the need for the improvement of principal secondary rural highways. The Federal-Aid Highway Act of 1944 provided funds not only for the old Federal Aid or Seven Percent State Systems, but made substantial appropriations to improve secondary or feeder roads. Highway engineers will thus be required to produce at moderate cost all-weather rural secondary roads that can be economically maintained and safely operated. They are now sufficiently experienced to do this job.

HIGHWAY ENGINEERING PROBLEMS

Any discussion of highway engineering should include some of the unsolved problems. One of the most annoying is to provide

PUBLIC ROADS ADMINISTRATION

DAVISON LIMITED HIGHWAY THROUGH HIGHLAND PARK IN METROPOLITAN DETROIT

The improvement is built on a half-block strip of right of way. Though some highway authorities believe that even this right of way will be inadequate for the future, large numbers of vehicles move safely over this urban expressway.

PUBLIC ROADS ADMINISTRATION

TRAFFIC CONGESTION IN WASHINGTON

A scene at M Street and Wisconsin Avenue. The horse and buggy moved faster sixty years ago than is possible for an automobile in some city streets today.

PUBLIC ROADS ADMINISTRATION

BALTIMORE-WASHINGTON BOULEVARD, U.S. 1 NEAR ELKRIDGE, MARYLAND

The ribbon development impairs the safety and efficiency of the road.

FRIED-LEDER PHOTO

HENRY HUDSON PARKWAY, LOOKING SOUTH FROM
87TH TO 72ND STREETS, NEW YORK

This view shows the three lanes in each direction and the modified cloverleaf at 79th street. Note the park features, including river-edge promenade, playgrounds, athletic fields, and in the foreground a wide promenade which is over the tracks of the New York Central Railroad, as is the portion of the Parkway south of 80th Street. At 72nd Street the parkway connects with the West Side Highway.

FRIED-LEDER PHOTO

HENRY HUDSON PARKWAY NEAR GEORGE WASHINGTON BRIDGE

The Parkway is justly considered an outstanding example of highway planning and design. The New York Central Railroad tracks here skirt the river's edge before passing under the Parkway at the right of the picture.

joints in rigid-type pavement that will not deteriorate with time or cause operating defects. A great deal of money and effort have been expended for experiments to perfect details of the design of Portland cement concrete pavements. Cross-section designs have passed through several styles from a uniform slab 4 inches thick and 15 feet wide to 24-foot slabs with thickened edges up to a maximum of 11 inches. Now there is a tendency to return to a uniform-thickness slab of 8 inches or more in depth. The use of reinforcing steel has exhibited corresponding variations. Much concrete pavement now is laid without any steel reinforcing. Reinforcing at best cannot prevent cracks that result from overstresses, but is used to prevent separation of such hair cracks as develop. The length of rigid road slabs between joints is still to be settled. Engineers are reexamining the theory of heat expansion under varying climatic conditions and are questioning the frequency of former so-called "expansion joints." The introduction of the "dummy" or contraction joint at intervals of about 15 feet seems to promise a good deal of relief from former troubles. Corresponding studies have been made on various types of bituminous roads. The introduction of so-called "plant-mix" and "road-mix" construction about 1925 has been an epoch-making advance in road surfaces. The intermediate types of surfacing are made about 2 to 2½ inches thick of liquid asphalt and local material such as fine gravel or crushed stone.

A most important aspect of highway engineering and one long neglected is the subgrade. The subgrade is the term applied to the graded roadbed upon which the various surfacing courses are placed. There is ample evidence that unstable subgrades can destroy good pavements. The subgrade is unstable when it is subject to excessive deformation under loads. Deformations may be in shape or volume, or their combinations. Study of subgrade soils across the continent has resulted in a classification into eight groups, A-1 to A-8, arranged in order of decreasing stability. Soils below the A-4 group require special treatment. Somehow, they must be stabilized. A cheap and frequent method of stabilization is to build the last layers of the roadbed with material of unquestioned stability. Soils of classes A-1 and A-2 may be present throughout the highway. More frequently, such soils may have to be "imported" or borrowed from adjacent or even distant pits. In some areas, good local material cannot be obtained. Soil or subgrade stabilization then becomes a more serious and often quite expensive procedure but is absolutely necessary. Thus, for example, we find the practice of mixing coarse sand with subgrades carrying excessive clay.

The introduction of bituminous materials and lime and cement have been tried. These methods are generally more expensive than using layers of coarse gravel. Soil stabilization and subgrade stabilization are still evolving. The main fight, however, has been won in the recognition of its necessity. One persistent adverse soil condition is the accumulation over the years of excessive moisture under impervious pavements. Even in the driest areas increased moisture has been observed beneath sealed surfaces. Eventually, such an accumulation may soften good natural subgrades if they contain fine material. The escape seems to be in using coarser material as stabilizing areas beneath impervious surfaces.

Another basic element in modern highway engineering is the selection and control of the materials of construction. This is an extensive field for research and experiment and has required the establishment and operation of material-testing laboratories in every state and by the Bureau of Public Roads.

33 HIGHWAY CONSTRUCTION

BY HARRY C. COONS

HIGHWAY construction has been in progress a long time and roadbuilders have left an impressive record of their work. Just before World War II it was estimated that there were more than ten million miles of rural roads in service throughout the world, or about one mile of road for every five square miles of the earth's surface. Nearly one-third of this road mileage is in the United States where, on the average, there is a mile of road for every square mile of rural territory.

This tremendous total of existing roads is the cumulative achievement of a construction effort which began in remote ages; which has been halted for long periods, but is now in the midst of its greatest upswing. In 1940, the Department of Commerce reported that the world's road mileage had been increased by 27 per cent in the preceding ten years. In this country, at least, the volume of post-war highway construction promises to surpass that of pre-war years.

The techniques of roadbuilding have evolved during centuries of time. They were developed not only in the routine tasks of producing the ordinary local roads, but in carrying out great highway projects, some comparable in magnitude and purpose with the most famed accomplishments of our own day. Our modern methods of road construction are still in process of development; specifications conform to the best current practices as agreed upon by highway builders and engineers. Both methods and specifications are changed from time to time to make use of new materials and improved ways of doing the job. Roadbuilding, an ancient science, is nevertheless clearly modern in its spirit.

Perhaps the best way to describe the processes and techniques of present-day highway construction is to take up the items of work in the sequence in which they occur on a normal project—in other words, from the ground up. It will not be possible to describe all these items, nor even the most important in any great detail. The present purpose is to give an outline of the methods and standards used by modern highway builders.

But before describing the actual process of road-construction, a word should be said with regard to the timing of such work and the manner in which it should be performed.

TIMING AND MANNER OF CONSTRUCTION

Transportation by highway is an increasingly basic factor in the functioning of our national and regional economy. Therefore, the improvement of this transportation service by highway construction should be in constant progress.

Construction in general and highway construction in particular are high-powered stimulants of industrial activity and are unsurpassed in their ability to absorb and utilize surplus labor. Therefore, operations in these fields should be intensified in periods of depression or readjustment. Successful operation of this two-fold program requires a far-sighted policy of advance planning and right-of-way procurement on the part of highway administrators.

The manner in which work is done is of equal importance. In past years several different systems have been tried under which construction was carried on directly by the responsible governmental agencies. These sometimes involved the use of convict labor. More often the work was performed by force account with the employment of day laborers who were frequently citizens working out their road taxes. These methods have proved to be not only uneconomical in operation, but quite unsatisfactory in results.

Highways, wherever possible, should be constructed under the contract system and contracts awarded after competitive bidding. Practically all our modern highways have been so built. The system not only has produced good roads; it has also produced a large body of engineer-contractors who, by training and experience, are most competent to plan, supervise, and execute construction projects with economy and dispatch.

ROAD FOUNDATIONS

The highway is made up of the surface on which traffic moves and the structure on which the surface rests. The supporting structure consists for the most part of earth, cut or filled to meet the requirements of the specified vertical alignment of the highway. At stream crossings and at intersections with some highways and railroads, the highway is carried on bridge and grade-separation structures.

Although surfaces are designed and built to resist the effects of both traffic and weather, their period of useful life is limited. Sooner or later they deteriorate physically or their design or capacity characteristics become obsolete, and they must be replaced.

The subgrade is thus the sole permanent element in the road structure. For that reason it is good engineering and long-range

economy to prepare it properly to carry not only the type of surface immediately planned but the type or types which in the course of time will logically be selected to succeed the original surface.

The primary objective in constructing the subgrade is stability. In obtaining this characteristic the services of the soils engineer are essential in order that undesirable materials shall not be built into the structure and in order that the stability of proper materials may not be impaired by bad drainage conditions.

More than a hundred years ago, the great road engineer McAdam made the claim that he could carry any weight of traffic on a well drained subgrade. Perhaps the famous Scotsman claimed too much, but the fact remains that good drainage for both surface and subsurface water is basic to good subgrade construction.

The construction of a highway subgrade starts with the preparation of the ground on which it is to be built so as to assure satisfactory drainage conditions. This includes clearing and grubbing, the removal of muck and other undesirable material, the excavation of side ditches, and the installation of tile and culverts where necessary.

Materials for the subgrade must be selected which will stabilize properly. To resist deformation under load these materials must have properties of cohesion and internal stability; that is, they must possess mutual attraction between the smaller particles of which they are formed, and the particles of different sizes must be so proportioned as to give mutual support. Other soil properties affecting structural durability are capillarity, density, permeability, and flexibility.

It is sometimes necessary to mix and proportion the available soils to obtain the optimum possible degree of cohesion and stability. Much work is being done, both experimentally and in construction, in the use of admixtures of calcium chloride, sodium chloride, bituminous materials, and Portland cement to increase the cohesion of unfavorable materials.

In many states, the highway departments make intensive studies of soil conditions in relation to the requirements for both surface and subgrade construction. In Michigan, for instance, a soil survey is made of every project, and design recommendations have been developed for the more than 100 different soil types encountered.

In the actual construction of the subgrade, increasingly heavy equipment is being used with which larger loads are placed on the structure with greater speed and economy. When placed, this material needs to be thoroughly compacted to provide a stable, uniform foundation for the surface.

Compaction of sandy and like materials is obtained by wetting, while clay and loam soils are compacted mechanically. In the latter case, use is frequently made of the sheep's foot roller whose projecting teeth penetrate the soil and produce the maximum of compaction with the minimum of earth displacement.

In regions where there is a wide range of climatic conditions, special measures must be employed to cushion the road surface from the action of cohesive soils whose volume changes greatly in the presence of excessive moisture. In such cases a granular subbase 12 inches or more thick, is placed on top of the subgrade before the surface is laid.

When such a surface has been built on the completed subgrade, the slopes of the cuts and fills of the supporting structure are trimmed and sodded. Aside from its aesthetic value, this final treatment provides a natural sheathing which is resistant to wash and weather. So protected, the properly designed, properly built highway grade becomes a stable and permanent feature of the earth's surface.

HIGHWAY SURFACES

Highway surfaces are designed to perform three major functions, and they must be so constructed that they will function as planned. In the first place, they should give the road the characteristics of smoothness and strength suitable for its traffic. Secondly, they should provide inherent resistance to the tendency of traffic and climate to impair their service characteristics by wear and weathering. Finally, they should seal and protect the upper surface of the subgrade from the action of these deteriorating elements.

There are four or, if earth surface is counted, five general types of road surfacing that are designed and built to perform these necessary functions. Aside from cost considerations, the choice of the type to be constructed on a particular route is dictated by the volume and character of the traffic which it is to serve. These surface types, in the ascending order of their serviceability, are:

1. Earth
2. Gravel, crushed stone
3. Bituminous—several kinds
4. Cement concrete
5. Asphalt, brick, etc. on concrete base

1. Earth Surfaces. There are many thousands of miles of earth road in use today in all parts of the world. Frequently such road surfaces are stabilized with oil, and some interesting experiments

have been made in stabilizing soil with cement to obtain a satisfactory wearing surface. However, since the operations involved in building the earth road are little different from those required to build the subgrade, and usually are much more rudimentary, this type need be no more than mentioned in this review of highway construction.

2. *Gravel Surfaces.* The gravel road has been built and used from the earliest times. In the pre-auto period, our better rural roads were practically all of this type. Improvement and adjustment of the gravel road for modern traffic conditions has consisted of treating the surface material in such manner that it would better resist the effect of speeding cars in dislodging and blowing away the lighter elements of the surface in the form of dust which is dangerous to traffic and a nuisance to the roadside.

Thus stabilized, gravel road construction is widely used and produces surfaces which satisfactorily serve volumes of light traffic up to about 200 cars per day. Above that volume experience has proved that the loss of gravel amounts to from ½ inch to 1 inch per year. This condition necessitates maintenance operations above the economic level in costs.

Gravel roads are built of carefully graded aggregate and a suitable binding material. The best roads of this type are laid in two courses, with larger dimension aggregate in the first course and finer material in the second. Clay or soil, chemicals, Portland cement, and bituminous materials are most often used for binding and cementing the wearing surface.

Calcium chloride, which has deliquescent and hygroscopic properties, and sodium chloride, which has cementing properties, are the agents most commonly employed in building the true stabilized gravel surface. Mixing of the aggregate, soil, sand, and chemicals is done on the road or, as is now more frequently the practice on extensive projects, in a mixing plant.

The mixed materials are hauled to the site and spread on the prepared subgrade with blade spreaders or self-propelled spreading machines. Without the latter equipment, forms at the sides and in the center are required to hold the material in place and to indicate the contour of the crown slopes. The spreading machines produce uniform layers automatically. Each of the two courses is laid 3 or 4 inches thick and is compacted with multiple-tired rollers.

In wet weather the stability of these roads is derived from the interlocking action of the granular components which takes place when the latter are lubricated by the natural moisture. In dry weather stability is obtained from the cohesion of the binder soil

and the moisture film which is induced by the chemical admixtures.

Stabilized gravel road construction not only produces its own type of road surface; when bituminous material and Portland cement are used as the stabilizing agents, it is the basic process from which the bituminous, cement concrete, and other higher types of road surface have been developed.

3. *Bituminous Surfaces.* There are a number of kinds of bituminous surfaces now in common use, which are generally classified under the two headings of "low type" and "high type." The difference between the two classes depends on the grade of bituminous material and the kind and proportioning of the aggregate and fines employed in the mixture. Bituminous surfaces of both types are equally applicable for new construction and for resurfacing worn roadways.

Bituminous oils are frequently used as dust palliatives and binders on earth and gravel roads. However, the real bituminous surfaces are ordinarily constructed by laying one or more courses of aggregate and filler bonded with a high viscosity asphaltic oil on a gravel base. Whether the gravel is old or new construction, it should be well shaped and compacted and is usually treated with a prime coat of cut-back or emulsified asphalt or tar before the surface material is placed upon it.

The materials for the bituminous surface are sometimes mixed on the road or by a traveling plant moving along with the construction operations and dumping its product directly in place on the roadway. The difficulty of controlling the very critical element of moisture content with these methods has led to the general use of a stationary plant. The mix is delivered from the plant to the location by truck and, as in stabilized road construction, is placed on the road by a spreading machine and is then finished by rolling. The compressed surface is from 1½ to 3 inches thick.

Another very useful low-type bituminous surface is constructed by a penetration process. Crushed stone is placed on the roadway just as is done in building a macadam surface. Asphalt or tar bituminous cement is then applied under pressure to penetrate the upper strata of the stone. Fine stone particles are dusted on, and the surface is rolled to the proper compaction and form.

The well built and maintained low-type bituminous surface provides very excellent riding qualities. It is especially suited for application to roads with medium to high volumes of light weight traffic units. However, where there is very high-volume usage or a significant proportion of heavy trucks in the traffic stream, the surface requires better support than gravel can give. Bituminous con-

crete is designed to extend the service of bituminous pavements into this heavy duty field.

There are two kinds of bituminous concrete surfaces, both classified as high-type pavements. One kind is laid on a non-rigid base, usually stabilized gravel or macadam, and is particularly applicable to heavily traveled trunkline routes with a small component of heavy units. The other kind has a concrete base not less than 6 inches thick, and combines smooth-riding quality with the ability to carry heavy volumes and heavy vehicles.

On gravel, the base must be well compacted, drained, and shaped, and a priming coat is applied by the method used in building a penetration bituminous surface. When a concrete base is used, the upper surface is scored to provide a firm juncture of the base and the wearing course; this surface must be thoroughly clean before the priming coat is applied.

The bituminous concrete consists of aggregate—usually crushed gravel or stone, mineral filler, and asphalt cement mixed hot in a plant and placed on the road by a mechanical spreader. After rolling, the thickness of the finished surface varies from 1 up to 3 inches, ordinary practice being to have the minimum thickness in the center of the roadway and a greater depth at the edges.

An important field of usefulness for the bituminous concrete surface is in the rehabilitation and modernization of old and worn concrete pavements. In preparation for resurfacing of this character, badly broken portions of the pavement are repaired, poor drainage conditions are corrected, and frost-heave material is removed.

Narrow pavements are trenched and widened on both sides with a strip of hot mixed asphaltic binder 6 inches thick. The whole surface is then cleaned, coated with an asphaltic emulsion, and then surfaced with the bituminous concrete mixture laid in two layers to a total thickness of two inches.

In recent years, thousands of miles of old pavement on important trunkline routes have been fitted by this treatment for further service as transportation arteries.

4. *Cement Concrete Surface.* The concrete pavement is the heavy-duty road surface. It is designed for intensive useage by both light and heavy vehicular units and every step of its construction is aimed to contribute some element of strength, wearing quality, or smoothness for that service.

In designing the concrete surface, engineers have utilized the hardening quality of Portland cement not only to stabilize the aggregate materials, but to solidify them into a rigid slab. Because of its large bearing surface on the subgrade, this slab is able to

carry vastly heavier wheel loads than the flexible gravel and bituminous surfaces which impose these loads on a small portion of the supporting structure.

This type of construction also utilizes the hardness of cement to make the durable aggregates and granular materials used in other surfaces better able to resist the wearing action of passing wheels. Painstaking finishing operations have been devised to produce a smooth, even surface to compensate for the lack of the flexibility and resilience which give the bituminous surfaces their fine riding qualities.

In modern concrete road construction, the slab is ordinarily 7 to 10 inches thick. To increase its resistance to rupture under load, steel reinforcement is added, and the edges, where some of the most critical stresses occur, are thickened about 2 inches. Wire mesh is the reinforcement commonly used and it is laid on the first course of concrete before the final surface course is poured. To center its effects in the portion of the pavement which takes the pounding of traffic, the steel is placed about 3 inches below the surface.

The rigidity of reinforced concrete would cause destructive stresses to result from wide variations of temperature if it were built as a continuous solid structure. To guard against such effects, the slab is divided into sections transversely and along longitudinal center lines with sufficient separation between sections to permit expansion and contraction to take place.

The joints are kept open and protected from the intrusion of moisture and dirt by building or inserting bituminous fillers into them. At the same time, tie bars or dowel pins across the joints serve to couple the slab units together and to transfer vehicular loads from one slab to the adjoining one.

Much progress has been made in improving methods for finishing the concrete slab to provide a smooth riding surface and for preventing deterioration of a surface so built. While this result requires great care in preparing the base and in placing the first course of concrete and reinforcing material, it especially involves the treatment of the surface course.

After material for this course has been dumped in the forms and hand or machine spread to approximate required thickness, the whole mass of concrete in the vicinity of forms, construction joints, and all transfer joints, is thoroughly vibrated. This is done to assure maximum density of concrete round these points. The surface is then ready for finishing operations.

Finishing machines riding on the forms and spanning the width

of slab under construction are used for this purpose. These machines are equipped with two sets of screeds which shape and smooth the concrete as the machine is moved forward. Two passes are made over each section of the work: the first pass is a leveling and preliminary finishing operation; the second is intended to take out the irregularities left by the first.

The longitudinal float is employed to remove the series of transverse ribs and variations in surface height which the finishing machine usually leaves even when most carefully adjusted and operated. This device is a long framework which, like the finishing machine, rides on the forms. Screeds operating across the pavement iron out the remaining irregularities and make a more uniformly smooth pavement surface.

Scaling of the surface after the pavement has been in use some time causes roughness and deterioration which impairs the riding quality; it was one of the many problems of concrete pavement construction for which research has found a solution. Scaling has two chief causes. The first is "bleeding," which is the rising of free water, cement, and other fines to the surface due to the settlement of the heavier solids. These lighter components harden into a thin, brittle layer which eventually scales off under traffic. The second is the use of chemical salts for ice control. These salts by chemical or mechanical action, or both, cause disintegration of the surface.

Scaling has been eliminated by the use of air-entraining cement. This cement has the property of causing the concrete to entrain very minute, disconnected air bubbles. These minute air bubbles collect around the particles of fine aggregate and materially change the properties of both the plastic and hardened concrete. Before setting, air-entraining concrete is more plastic, can be placed with less segregation, and the tendency to bleed is greatly reduced. When hardened, it has greater resistance to the effect of freezing and thawing and the action of chemical salts.

5. *Brick and Asphalt on Concrete Base.* The bituminous concrete surface on a concrete base is the most universally used of the several types of pavement which were devised to combine the carrying capacity of concrete with the exceptional riding quality of the bituminous surface. Another such surface is the sheet asphalt pavement which is very popular as a surface for metropolitan avenues, and which is sometimes chosen for rural highways.

The asphalt surface is usually laid on an 8-inch cement concrete base and consists of two courses: a binder course of asphalt concrete, and a top of wearing surface of asphalt mortar. This type involves the use of less quantities and smaller size of aggregates and therefore

requires a larger proportion of asphaltic material, usually of the highest quality.

The brick surface on concrete probably stems from the time when brick was favored as giving good footing for horses. It is now rarely built for the use of rural highway traffic. Its application today is largely confined to the areas at the gutter and between car tracks on city streets. It is used most frequently in combination with an asphalt surface.

CONCLUSION

Road construction will play a great part in the era of expanded highway use in which we are just entering. New conceptions of design have been evolved to meet the needs of an ever-growing traffic and these are attracting the greatest public interest. However, it is safe to say that there will be a parallel development of new materials, improved equipment, and revised and perfected methods in the construction field which will have a profound effect in shaping and extending the highways of the future.

34 MAINTENANCE OF THE HIGHWAY

BY S. O. LINZELL AND H. D. METCALF

"THERE is nothing permanent but change." This statement is particularly applicable to highways which are constantly changing due to such factors as the march of progress, weather conditions, and traffic use.

Immediately after the completion of construction of a highway project, change begins. To offset or retard the wear and to preserve the original investment are the principal objects of highway maintenance. The design and construction of a highway are based on some known factors and various other assumptions which may not be true before the highway has reached its life expectancy. Adequate preventive maintenance eliminates the need for major repair operations, which are a certainty if maintenance is neglected. Plugging the little leaks in a dike prevents a flood. Minor additions and betterments bridge the gap between the design assumptions of today and the actualities of tomorrow. The summer resort road of today may be the only outlet for an oil field discovered tomorrow. The deficiencies in a highway which result from these indeterminate factors become the responsibility of a maintenance organization. The broad view of highway maintenance, therefore, generally includes three phases: preventive maintenance; repair; and additions and betterments.

SCOPE OF MAINTENANCE

Patching holes in a road surface represents a small portion of the whole maintenance problem for a highway network. In its broadest sense maintenance of the highway covers a large field of operations, the function of which is to keep motor traffic moving easily, safely, and economically. It involves operation of a highway transportation system excepting only the ownership and operation of the vehicles which use it. The physical maintenance of the road itself includes as major items of work the pavement surface, its foundation, base or subgrade, the drainage system, bridges, culverts, and retaining walls. But to these must be added other responsibilities not so obvious. Traffic services, such as the removal of snow and ice in the northern latitudes, assistance to traffic during floods and cleaning up the aftermath, providing detours, temporary routes, and run-arounds made necessary by construction work, wash-

outs, landslides, or other causes, are all considered essential functions of a good maintenance organization.

The simple yet legible sign system for information and warning has a marked effect on reducing congestion on the roads, gives direction to traffic, and prevents accidents. Pavement marking which tends to channelize traffic is being used more extensively. The maintenance of these traffic aids is a major maintenance problem requiring well organized special crews together with good engineering to achieve satisfactory results.

The character, volume, and speed of traffic are continually changing. Highways designed for certain assumed traffic conditions do not always fulfill the requirements. In order to perform effective public service, highways must be kept up to date. To do this requires many minor additions and betterments such as minor curve widening, installation of guard rail, culvert extensions, or elimination of deep ditches close to the pavement. Such operations in isolated or widely separated locations are not adaptable to economical contract work and usually are considered a normal function of a maintenance organization.

In built-up suburban areas and in sections of the country primarily devoted to recreation, the aesthetic features of the highway cannot be neglected. This requires erosion control, weed mowing, and vegetation regulation, together with the maintenance of such facilities as roadside parks and other conveniences for the motorist.

The large investment in highway bridges requires constant vigilance calling for a high order of skill to keep them in a good state of repair and a still higher order of skill to widen or strengthen them to meet the increasing demands of motor transportation.

ORGANIZATION

Regardless of its size, an efficient highway maintenance organization follows a certain pattern which is a combination of a line organization and a functional organization. Because of its diversified nature much of the work is specialized, requiring skilled functional supervision. Some of the work, generally classified as routine maintenance, is of such simple character, however, that it can be handled without especially designated supervisors.

If the basic organization is built up entirely from specialized gangs, each attending to certain phases of the work, it results in several gangs traveling over the same roads, often neglecting certain obvious deficiencies that do not fall within the scope of the work assigned to any one gang. To achieve the highest order of maintenance requires a balanced organization consisting of patrol gangs

who look after the routine maintenance work requiring the lower order of skills and special gangs responsible for the work requiring particular knowledge and ability.

Patrol maintenance is essentially a system of organization whereby small crews are responsible for the routine and miscellaneous maintenance work in a given area or over a section of road. This differs from gang maintenance in which the organization consists of larger groups of men who are assigned to work over larger areas or on different roads, on assignment made from day to day. Both systems of organization have certain advantages and a combination of the two best fits the overall needs of a highway network. Such work as weed mowing, shoulder maintenance, and pavement patching is best accomplished when carried out by patrol crews. An operation such as bridge repair or bituminous surface treatment requires both special skill and equipment, calling for skilled crews who move from place to place on assignment. To obtain the greatest benefit from a patrol system, it is advisable that patrols operate from outposts strategically located over the network and manned by personnel living in the neighborhood. Though outposts are a valuable accessory to a patrol system, nevertheless, as a system of organization it may be operated without outposts and achieve excellent results. There is no inflexible rule as to the size of a patrol crew; in general practice, however, three to eight men with the necessary equipment are adequate.

CLASSIFICATION OF HIGHWAYS

Rarely are highway departments provided with sufficient funds to maintain adequately all their roads at a standard that would suit the critical maintenance engineer. It is necessary that judgment be used in the deployment of maintenance forces and the allocation of maintenance funds to obtain generally satisfactory maintenance.

To eliminate inconsistent performance and to achieve economy of operation, the various roads in a highway network should be classified according to some system. The most important heavily traveled roads naturally require priority in maintenance, as traffic volume should receive first consideration. Route continuity, highway environment, and other factors must also be taken into account. Highways in suburban residential or in public park areas require a different type of maintenance from those in rural areas. Similarly, highways in industrial areas require still another type of maintenance.

An examination of the standards of maintenance that can be varied to suit the many classes of highways is in order at this point.

A main object of highway maintenance is to provide a smooth riding surface. However, smoothness applied to highways is a relative term. A road that is amply smooth for a small volume of low-speed traffic may be considered very rough by high-speed heavy traffic. Superelevation of curves or widening of very sharp curves is of vital importance on a high-speed, high-traffic-volume road, but of very minor importance on a low-speed light-traffic road. Shoulder maintenance may vary in quality depending on the volume and nature of traffic and also somewhat on environment. Maintenance of shoulders eight feet or wider with grass or aggregate cover is desirable on the main roads, but a lower quality of shoulder maintenance is justified on roads of minor importance. Right of way housekeeping allows extreme latitude in the exercising of judgment. Important roads of well developed suburban areas call for the highest quality of right of way maintenance; grass or weeds should be cut frequently and no trash or debris should be allowed to accumulate.

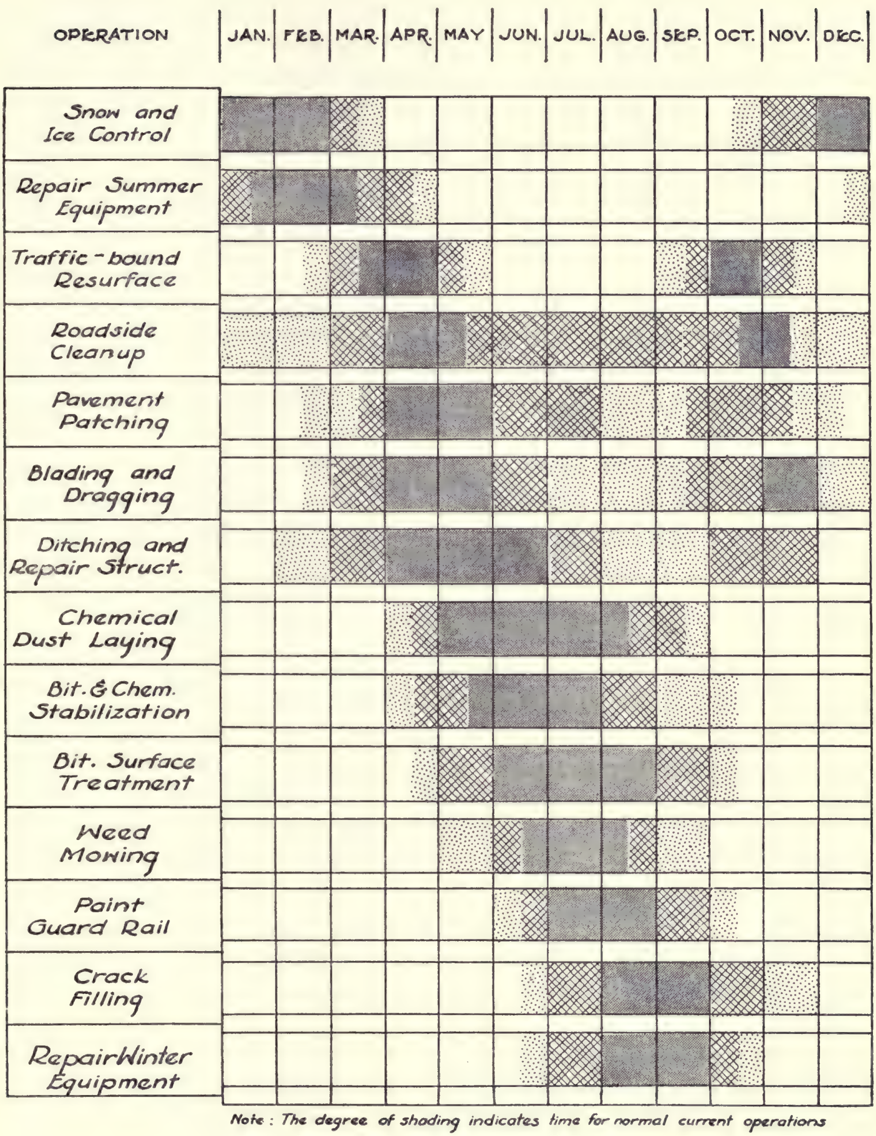
Pavement marking with centerlines and no-passing zone lines is extremely important on heavily traveled roads but unnecessary on those of low traffic volume. The extensiveness and clarity of route marking and warning signs should be modified to suit the volume of traffic.

Traffic services, such as snow removal and ice control, present the fullest latitude for modification of operations to suit the traffic requirements. The traveling public demands consistent and dependable service in this field of activity. Careful coordination is necessary to prevent spotty execution; the work of many small crews operating simultaneously must be so arranged that first preference is given to the same roads in adjoining districts. The sub-division of a highway network into classes of roads with established orders of priority is vitally necessary for effective snow removal and ice control.

Many of the above expedients are used by skilled maintenance engineers to stretch the maintenance dollar to its fullest effective use.

SCHEDULING OF OPERATIONS

Highway maintenance, being a governmental function, is subject to the restrictions imposed as safeguards in governmental procurement. A longer period is required to make purchases and secure delivery than in commercial enterprise. Confusion and a succession of minor crises can be avoided by scheduling and planning operations. Although occasions arise when unforeseen repairs are necessary, the majority of the maintenance and repair operations may be



Seasonal Schedule of Routine Maintenance

anticipated by experienced engineers. For guidance of key personnel and as an aid to planning, many state highway maintenance bureaus prepare a maintenance calendar which charts the period of the year when the principal phases of the work are most active. Reference to this chart and adherence to it by lower levels of the organization result in orderly procurement of materials, disposition

of equipment, and execution of the work. A sample chart from a typical state highway maintenance bureau is shown herewith. Many other customary administration devices are used to keep an organization on its toes, such as monthly letters on the immediate seasonal operations, conferences, and schools for instruction of supervisory personnel.

However, unforeseen emergencies will arise. The promptness and efficiency with which these emergencies are handled "type" the maintenance organization in the mind of the public. No matter how well roads and bridges are maintained day after day and month after month, a road or bridge failure causing public inconvenience for too long a time brands the maintenance organization as incompetent. Emergencies must be handled promptly. Highway maintenance is nothing more or less than maintenance of a transportation system which is a vital part of the economy of any civilized community. Successful highway operations involve preparedness to face any emergency by providing adequate stocks of materials and equipment and skilled personnel.

BASIC TECHNIQUES OF HIGHWAY MAINTENANCE

It is said that "a road is no better than its base"; also that "drainage is the fundamental" of all good maintenance. These two generalities like most adages require qualification and amplification; for if taken too literally in all cases, they may result in impossible situations. Pavements and roadbeds must be drained at least as well as was contemplated in the original design. Failure of the base of a pavement due to any cause whatsoever will result in failure of the wearing surface. It is therefore the aim of the maintenance engineer to keep the pavement and base well drained; for if subgrades become saturated or inclusions of water occur in the pavement structures that were not originally contemplated, failures will occur.

Drainage is the removal of harmful water from the pavement or subgrade or right of way. Surface drainage is just as important as subsoil or lateral drainage. Failure to provide adequate drainage inevitably results in subgrade, base, and eventual surface failure.

Chronic failures which show up as surface failures require careful diagnosis, because they may progressively result in failures of the base and subgrade or vice versa. Failure of any one element may result in failure of the others. Successful correction or repair depends on the diagnosis of the fundamental cause of failure.

A successful pavement-repair policy requires careful engineering analysis. In the early stages of deterioration, repairs of a pavement

in kind are favored just as it is desirable to patch a blue serge suit with blue serge material. When inferior expedients are resorted to, a rear-guard action against the forces of destruction is indicated. When repairs are made with materials of durability and strength superior to those in the original construction, poor judgment is displayed and frequently the repair becomes a sore spot almost as bad as the original failure or may be the cause of additional failures.

As carefully as highway engineers design pavements, failures occur which have resulted in the development of ingenious maintenance practices. Not uncommonly, concrete pavement slabs settle due to subgrade failures. These settled slabs are raised to the original grade with very little interference to traffic by a process called "mud jacking." Holes are drilled vertically through the settled slab and a "mud" made of soil, water, and Portland cement is pumped through the holes. The pressure of this "mud" gradually lifts the slab back to its normal position. The cement causes the "mud" mixture to harden thereby creating adequate support for the pavement slab.

Another ingenious process is one whereby joints and cracks are "sub-sealed" to prevent the entrance of water into the subgrade. Water entering the subgrade tends to soften it and when it becomes too soft the pavement slab will break under heavy loads. Sealing these joints by pouring hot bituminous materials into them is a recurring maintenance expense which effects only a temporary seal. A commonly used practice to achieve a permanent seal is to force hot bituminous material under and up into the joint under a pressure of 30 to 40 pounds per square inch. Holes are drilled vertically through the concrete slab about one foot from the joint to be treated. Hot bituminous material is pumped through the holes. The material spreads to and up into the joint and hardens as it cools to a stiff plastic consistency. The joint is thus effectively and permanently sealed and any cavities between the pavement and the subgrade are effectively filled.

Close maintenance of pavements is the term used today that reflects the old "stitch in time" adage. Close maintenance should be attained by every maintenance organization. It not only produces the most satisfactory results, but also is the most economical. To accomplish this end requires the frequent patrolling of the roads. A minor failure repaired immediately is less expensive in the long run and prevents public irritation. If postponed, the resulting major repairs may appear to have a lower unit cost but actually have an excessive total cost. During periods of unfavorable weather, temporary repairs may be made until a suitable time when the condi-

tion can be permanently corrected. Weather is no longer an excuse for the failure of a maintenance organization to perform close maintenance operations.

SAFETY

Heretofore, the discussion has been confined to the physical maintenance of the highway structure. Equally important is the maintenance of the highway as a safe artery of travel. The speed and volume of traffic on a highway may change before the highway has deteriorated to the point where completely new construction is economically feasible. These increases may not physically harm the highway but can definitely impair the safety of travel. The goal of a maintenance engineer is not only to maintain the pavement, bridges, and roadbed, but also to maintain or improve the safety of the highway. To hold the accident rate per vehicle mile of travel to a minimum requires alertness, foresight, and ingenuity. Shoulder maintenance, pavement widening, superelevating of curves, centerlining, installation of speed zone and warning signs, guard rail erection, crown reduction, and ditch elimination are some of the expedients that are continually being used to keep the accident rates low.

Maintenance of traffic flow is another feature of highway maintenance that cannot be overlooked, especially in the heavily populated regions. This calls for an adequate understandable system of route marking combined with pavement markings to channelize traffic. Confusion and congestion are created by failure to provide these facilities, resulting in the reduction of the capacity of a highway to handle the maximum amount of traffic and leading to an increase in the number of accidents. Route marking and centerlining are an essential part of the operation of a highway system. Many instances may be cited where the provision of well designed centerlining or channeling, route marking or other devices has eliminated the necessity of costly new construction.

The maintenance of traffic flow during the winter months in northern latitudes by the removal of snow and ice is of great importance. Removing snow from the pavement surfaces is a problem of organization and involves the selection of the right type of equipment. Of paramount importance is the necessity of getting the snow removed promptly before traffic has time to compact it to dangerous ice. Starting early and keeping up with the storm is a guiding operational policy that pays dividends in elimination of subsequent traffic slowdowns and stoppages. Snow and ice may be removed by the use of snow plows or the use of chemicals, while traffic may

be protected by the use of abrasives. Each method has its advantages. Our economy is tied to motor travel by highways. Many prosperous communities rely on all foodstuffs, materials, and finished products of industries moving in and out daily by motor vehicles. The arresting of traffic flow over a major portion of a network for twenty-four hours or more presents the aspects of a major disaster.

MAINTENANCE COSTS

Experience is the best guide to measure what reasonable maintenance costs should be. The variations of traffic, climate, material costs, labor rates, adequacy of existing roads, and other factors make it impossible to arrive at a definite formula for general application. Progressive deterioration of a highway system may be caused by several factors. First, lack of sufficient funds; second, a substandard maintenance organization undermined by incompetence and waste and bad policy; and third, the highway structure is not capable of carrying the traffic load. Likewise, evidence of waste, extravagance, boondoggling, and unbalanced expenditure in proportion to results indicate excessive maintenance expenditures and allotments. Continued intelligent adjustment of these funds to fit the existing conditions is necessary to achieve the most economical and satisfactory highway maintenance.

DELAYED MAINTENANCE

There comes a time after a road has reached a certain stage or has had a certain amount of usage when spot maintenance fails to keep up with the rate of deterioration and the maintenance cost is excessive. When this stage is reached a high order of engineering judgment is necessary to determine the most economical course of procedure. Generally three avenues are open: (a) a preservative treatment; (b) an overlay or resurfacing; or (c) rebuilding. Besides the technical considerations, the economic aspects deserve careful study. This problem then becomes one for joint consideration of both maintenance and design engineers.

In conclusion, the motto of the maintenance organization of today should be: "At your service twenty-four hours each day, three hundred sixty-five days each year."

35 VISIBILITY AND HIGHWAY LIGHTING

BY SAMUEL G. HIBBEN

THE best possible provisions for highway construction and the most diligent patrolling, the best design of vehicles and the most conscientious actions of the driver—all are nullified if vision and visibility are faulty. Much remains to be done to guard against this defect.

DAYTIME SEEING

During daylight hours the "seeability" of motorists is dependent chiefly upon the color and the physical character of the roadway surface, upon its orientation or its direction, influenced considerably by lane markings and painted insignia on the surface, and upon roadside obstructions. The American Road Builders' Association has recommended a visibility distance of 1,800 feet—one-third of a mile—for modern driving speeds. At sixty miles per hour, the warning time is twenty seconds. Obviously, sharp curves with shrubbery or other concealing objects on the inner arc will limit long range vision, while fog and other adverse atmospheric conditions increase the importance of road surface markings, reflector signs bordering the paving strips, and intentional changes in the roughness of the highway surface which by physical means (such as vibration) give warnings supplemental to the visual ones.

However, the great abundance of natural daylight, with some 1,000 foot-candles incident upon the roadway even on heavily overcast days, permits easy discernment of objects as large as a man to a distance of many times the safe stopping distance of the vehicle, if the line of sight be unobstructed. Traveling at 50 miles per hour, this stopping distance is on the order of 100 yards, and during almost any conditions of fair-weather daylight an object as small as a cat can readily be seen on a highway at considerably greater distances.

Where highways generally run east and west there are frequent early morning and late evening hours when reflected glare from the roadway surface materially decreases visibility. Excess light into the eye contracts the pupillary opening and tires the retina so that the driver is partially blinded. Remedial measures for this condition may be found, in part, in a choice of surfacing materials, not forgetting the selection of the gravel, turf or highway border-

ing materials. The greater the contrast in brightness, or reflectivity of these, the better.

To relieve daytime glare some attempts have been made to incorporate dark colored pigments into concrete, but while these might lessen sunshine glare, their detrimental effect on nighttime vision is so great that under ordinary circumstances they are not recommended. A windshield filter of tinted plastic would serve the purpose better. Obviously, items of vehicle design such as windshield area can improve daytime visibility; but aside from intelligent landscaping, control of the placement of roadside advertising signs and structures, and careful surface markings, there is little that the highway engineer or the citizen can do to improve daytime visibility after the highway has been built. Regarding surface markings, and to provide contrast with snow, it is generally found that the semi-gloss chrome yellow painting is preferable, and self-luminescent (phosphorescent) paints are being studied. Brilliant fluorescent dyes can double the brightness of some marking paints, but so far early fading has necessitated frequent repainting. However, the direct glare from the primary light (sun and sky) is so much greater than brightnesses of surroundings, that reflectances are relatively unimportant in reducing daytime glare. The sun has a brightness of 450,000,000 footlamberts compared to 1,500 for the moon, or to 59,000 for a bare 100 watt Mazda filament lamp.

Diffuse Reflectances of Highway Materials *

Clean Concrete	Approx. 45%
Oiled Dirt	15
Tarvia Gravel	5
Dark Brick	15
Powdered Shell	70
White Paint	80
Green Grass	10

* It should be noted that if the reflectance of a good diffuser be taken as 100% when measured normal to the flat surface, this figure will be in the neighborhood of 5% when viewed at 80 degrees from normal, and that wet surfaces act as mirrors when viewed by the motorist.

NIGHTTIME SEEING

Increased highway traffic density at night and the full, safe utilization of a large capital investment call urgently for remedial measures to increase nighttime visibility, to test and train the seeability of motorists, to reduce headlight glare, to provide artificial illumination on all major routes (now roughly 50,000 miles in the United

States), and to provide roadside aids to vision. Visibility on the highway at night depends chiefly upon contrasts in brightness of surfaces and surprisingly little upon color of light or of object, or upon the optical acuteness of the driver unless he be badly abnormal. Under present conditions, the illumination from vehicle headlamps alone cannot guarantee safe and comfortable nighttime vision, and overhead sources are needed for satisfactory discernment, the types of which are (see illustrations after p. 366):

1. Discernment by surface detail, the object itself being illuminated with sufficient light to permit discrimination, or quick recognition.

2. Discernment by silhouette, the object being seen in bulk, with outline wholly or partly contrasted against the brighter background.

3. Discernment by glint, the object or detail of an object being perceived through specular reflection of light from some polished surface.

4. Discernment by shadow, in which the presence of an object is inferred from its shadow.

It will be enlightening to appraise each of these methods of discernment, and to be sure that in practice none is neglected.

(1) In important city districts there should be sufficient street illumination so that objects whether cars, persons, or obstructions may be seen by surface detail. This means that pedestrians may be clearly recognized. It means one footcandle or more upon the roadway; it may mean 100 lumens of generated light per running foot of roadway. A reasonable approach to uniform horizontal illumination but with a considerable amount of vertical illumination is essential for this purpose. Placement of posts at curb-line is usual. While it might be desirable to provide similar illumination in residential sections and on inter-urban highways, this cannot be justified economically today and recourse must be had to discernment by silhouette.

(2) The achievement of silhouette vision is based upon pools or large areas of lighted roadway background, the obstruction itself being less bright. This condition in turn depends much upon the physical character of the road surface, i.e., whether of rough macadam, transverse brushed concrete, rain-smooth mirror-like surfaces, etc. Dry concrete in service usually reflects light diffusely and with a reflectance coefficient on the order of 25%, but especially at nighttime only those particles or faces of surface materials tilted toward the observer appear bright. Also the brightness of the area beyond and behind the obstruction is the important one, not the area between observer and obstruction. When, as in the case of dark as-

phalt or tar materials, the reflectance drops to 10% or lower, then either the incident illumination must be increased or else—and this is a matter of careful engineering—remote light sources should be situated above (not to the side of) the line of viewing, so as to benefit silhouette vision but with a minimum of glare. Widely spaced illuminants do better when mounted high over the traffic lane, not on the curb-line.

(3) A diffusely reflecting concrete highway may provide good silhouette vision on a dry night but seem almost totally black on a wet night when reflections are specular. Faulty placement of the lighting units is partly responsible for this condition. Under ideal conditions the light sources might be mounted along the curb-line or on poles bordering the roadway, but for good visibility under all conditions of weather, the line of overhead lighting units should be closely above the line of the traffic, and on the outer arcs of curves; hence such specular reflection as may come toward the driver will assist in this glint discernment. A fan-like horizontal spread of the rays is better than a small, bright source. Ideal conditions would favor horizontal bars of light, as wide as the roadway.

Nighttime visibility is increased by a ridged or fluted configuration of a formed concrete curb or dividing strip, since these flutes present small areas that are approximately normal to the line of vision, roughly the same as the line of the automobile headlight beam. Since the latter grazes the roadway, all specular reflection is away from the driver, hence the headlamp can be chiefly relied upon only in discerning the roadway object by direct illumination, not much by silhouette. The latter effect, especially when overhead street lighting is meager or absent, is improved by transverse fine ridging at dangerous intersections, etc.

(4) Shadow discernment is of value on some sharp curves, or at masked intersections. Naturally if light sources must be small, it is better to have one on each side of an intersection rather than a single one above it.

CHARACTERISTICS OF LIGHT SOURCES

Any type of overhead street lighting, especially on inter-urban highways, must be a careful compromise between the desirable objective of developing an approximation of equal illumination all along the road—this meaning extremely high candlepowers of sources at angles approximately 15° below the horizontal—and the contrary objective of avoiding glare by keeping direct light out of the driver's eyes. Glare in the line of sight can be worse than darkness!

Glare is of two major kinds. One is the blinding effect which is the product of the candlepower of the glare source in the direction of the eye, and the angle which the glare beam makes with the angle of vision. The second (and mostly a discomfort) effect depends upon the intrinsic brightness of the source and the contrast with its background. A brilliant lamp located within 10 degrees of the line of vision, for example, will produce both blinding glare and general discomfort. If the lamp is surrounded by a large diffusing enclosing globe, the discomfort glare will be greatly reduced but the blinding glare will remain substantially unchanged—that is, if the total flux or volume of light is large.

The first remedy for both classes of glare is to mount the sources as high as can be economically justified but generally higher than has been past practice, and then to have the light beams very carefully regulated in proportion to the ratio of spacing to mounting height. Where the spacing is roughly five times the height, the maximum candlepower of the unit should be at approximately 22 degrees below the horizontal. Where the spacing is eight times the mounting height, the maximum candlepower should be at about 13 degrees below the horizontal. On a medium traffic thoroughfare [1] it is not uncommon to find a mounting height of 25 feet and a spacing of 200 feet, equivalent to a spacing ratio of 8.

Heights of 30 to 35 feet rather than 25 feet tend toward more even distribution, much reduced glare, and permit the use of larger and more efficient light sources. Spacing ratios of 8 to 1 should not be exceeded for medium and light traffic routes and perhaps 5 to 1 for business districts.

Whatever the light source, the utmost care in engineering is called for in order that the generated lumens be directed to the street surface effectively. In business districts it is possible to utilize some 75% of the bare lamp (lumen) output and some of the light can be justifiably spread over building facades, sidewalks, etc. Where it is desirable, as on the inter-urban highways, to confine the light to the surface of the street, a utilization of 50% is attainable although the present average in this country is nearer 25%.

In extensive highway illumination, it is present American practice to employ the series system of power distribution, meaning a single wire looping out from a supply point and connecting several dozen to several hundred lamps in the same series circuit. Tungsten filament lamps designed for series burning operate at a relatively high current (up to 20 amperes) and low voltage and are decidedly

[1] Medium traffic is 500-1,200 vehicles per hour; light traffic is 150-500 and heavy traffic is 1,200-2,400.

more efficient than multiple burning lamps of comparable wattage. The voltage of the loop or circuit is the sum of the lamp voltages connected in it. On the other hand, multiple circuits are frequent in business districts and in many residential sections and a careful cost analysis should be made of which system is preferable.

COSTS OF LIGHTING

Costs of street and highway lighting are not easy to analyze since they include fixed charges, power, and maintenance. The capital investment in a highway lighting unit (pole, fixture, all electrical fittings and power supply accessories) may be on the order of $200. Fixed charges suggest careful analyses of the basic costs of the equipment; and far too frequently the major cost has been in the use of over-elaborate heavy cast-iron bases and ornamentation, and monumental supports with ridiculously small light sources at the tops. Studies of operating costs show that electric power is often not the only important factor; rather this may be the cost of lamp renewals and of glassware breakage. Years of study have disclosed what is the most economic design life of an incandescent electric lamp bulb, roughly twice the life of lamps used for ordinary interior lighting. Reducing the frequency of burnout replacements is highly advisable where remote patrolling is necessary or the mounting is higher; and largely for this reason attention has recently been given to high intensity mercury lamps that tend to have about three times the life of corresponding filament lamp sizes. The 250 and 400 watt mercury lamps now average better than 4,000 hours of burning life, or roughly one year's service.

RESULTS OF HIGHWAY LIGHTING

Costs of highway illumination naturally involve appraisals of results. No student of the subject can avoid the startling fact that during 1943, for example, motor vehicle accidents in the U. S. resulted in 23,400 fatalities and some 800,000 personal injuries, 70,000 of them involving permanent disability! Of these dead, 9,700 were pedestrians. In subsequent years the traffic accidents, and especially the fatal ones, have not ceased to be equally alarming. Since Pearl Harbor more than 200,000 motor vehicles have been destroyed in accidents and millions more damaged. Far too often the cause is poor visibility.

Post-war and future planning, therefore, must recognize that the best engineering talent must be directed toward making highways safer, and planning them for higher traffic density and higher speeds. Even though the vehicle-miles during dark hours are very

much less than in daytime, night fatalities are almost double the day fatalities. The peak of traffic usually occurs between 5:00 and 6:00 p.m., and as traffic density declines after that hour there is a normal expectancy of decrease in traffic deaths in proportion. The facts, however, disclose that the peak of traffic fatalities is usually between 7:00 and 8:00 p.m. and remains high until about 1:00 a.m. This situation is largely caused by poor visibility, and poor lighting.

Many communities are discovering that the citizens pay for street lighting whether they have it or not. A typical American city spent $750,000 annually for normal 100% street lighting service. An economy wave reduced this to 65% with an apparent saving of $262,500. However, in that year the number of night fatalities increased by 27 because of the darkness, and the total economic loss therefrom increased by an amount of $1,188,000. Thus the indirect costs of poor lighting amounted to 4½ times the actual "savings."

COLOR AND VISIBILITY

When the human eye is dark adapted as in usual nighttime conditions of silhouette seeing, it will be quite insensitive to color. In fact most hazardous objects are of dark or neutral tints and surprisingly little benefit is gained even when comparing a black automobile with a white one. Where the intensity of illumination is about 1/1000 of a footcandle, or equivalent to very weak moonlight, there is a shift (in retinal sensitivity) from photopic to scotopic vision and we lose the ability to discriminate between colors.

For these and other reasons the color of the light has relatively little to do with visibility in highway lighting since glare and direction of light are so much more important. The usual color range of illuminants is from the light yellowish-green of high intensity mercury through the yellowish-white of the tungsten filament lamp (2955° K color equivalent of a 2500 lumen 6.6 amp. lamp at 17.5 lumens per watt) to the lemon yellow of sodium vapor lamps. Theoretically the peak of retinal sensitivity roughly corresponds with the color of light of sodium vapor but actual roadway visibility depends more upon light and dark contrasts, and except for the value in marking certain fixed hazards, or indicating crossings, etc., the choice of an illuminant is basically one of costs rather than color.

During the experiences of dimouts and blackouts of World War II, there was a common error made in the choice of blue light rather than dim red light for cautionary usage. A yellowish-red color, when dealing with very low candlepower illuminants, provides much higher visibility under the same illumination as compared to a blue colored light. The eye becomes adapted much more rapidly to weak

illuminations of long wave character than it does to weak illumination of short wave quality. Under conditions of fog there is no consequential virtue in one color over another except as might be involved in the definite contrast of one light source with another. In short, red rays do not penetrate fog substantially better than white rays or other tints.

Safety engineering for highways must provide not only good illumination for normal conditions but must take into account the inevitable hazards of extremely adverse meteorological and health conditions. For nighttime visibility, very little more can be expected in the foreseeable future from headlamps on the vehicles. Today's job seems to be the one of making the roadway surfaces as crisply visible as construction knowledge can dictate—then to add into the plans an overhead lighting system and a roadside marker system as complete as is economically possible.

36 INFLUENCE OF THE CLIMATE ON THE HIGHWAY

BY HANS F. WINTERKORN

CLIMATE influences highways in a manifold and variegated manner; it may affect them directly through the action of its component forces and phenomena, or indirectly by its impact on social and economic conditions. Some of the climatic effects are obvious and simple, permitting easy recognition and description in terms of established physical laws; others are the results of periodic and rhythmic action of sets of physical forces and are more difficult to assay; still others are well hidden in an intricate relationship with topographic and geologic factors barely perceivable and expressible only in a qualitative way.

Climate is usually defined as the average condition of weather at a place over a period of years as shown by temperature, wind velocity, precipitation, and other atmospheric conditions. These atmospheric conditions extend into the pore phase of the uppermost soil layers; thus, changes in temperature and moisture in the atmosphere are reflected by similar though retarded changes in the soil. For this reason the kingdom of climate extends logically not only to the earth surface but to that depth within the earth crust which may be affected daily or seasonally.

A mild climate combined with other favorable factors invites settlement by man, out of which grows the need for communication and for highways; a severe climate is forbidding to settlement and exerts a retarding effect on general road development.

Soils are creations of climatic forces playing upon the available geologic materials and modified by the topography of the land. Some climates, while not especially attractive to man, form very fertile soils. At a certain state of civilization, the attraction of the fertile lands outweighs considerations of human discomfort, drawing in man and highways. The soil-forming role of climate is also of direct interest to the highway engineer who must consider the structural and traffic loads the soil will carry and who often uses the local soil as a structural material for highway bases and surface courses. He is very much concerned whether the climatic forces have produced and are offering to him highly cohesive, impervious clays, with a great potential water affinity, erosive silts, non-cohesive

granular rock particles ranging from fine sand to boulders, or combinations of these materials. Depending on their size-composition and their surface chemical character, soils represent good, fair, or bad materials for highway substructures and surface courses.

The highest art of roadbuilding is tailor-making the pavement to the supporting power of the soil and to the expected traffic weight and density. Since the soil and its bearing power are creatures of the climate the importance of the latter is obvious. However, this importance goes still farther. Climatic forces do not stop acting with the placement of a pavement over a soil. Now they attack the pavement itself, making it deteriorate irrespective of traffic and sometimes at a faster rate without than with traffic. Also, the soil underneath the pavement may now be in an environment totally different from its previous one; this change may severely affect its bearing power. A pavement will often cause waterlogging of the underlying soil and increased activity of slime forming anaerobic bacteria; this condition, also, tends to diminish the bearing power of the soil.

It is, therefore, important to consider the reaction to climate of a pavement system as a whole, extending from the pavement surface to a soil depth at which daily and seasonal temperature and moisture changes have fallen to zero. Such a system, if designed for greatest economy for a given type of service, should possess the ability to breathe. This means it should be pervious to water vapor, permitting the diffusion and evaporation of water normally collecting by condensation or otherwise underneath a pavement, and as impervious as possible to water precipitated on the surface. There exists a great similarity between this type of road structure and the human skin. As the latter becomes soft under an impervious plaster, in the same way many low-cost gravel and oiled earth roads which have given satisfactory though limited service fail after being "improved" by relatively impervious seals or pavements. The differential in upward and downward water-permeability which should be maintained for best service and greatest economy depends on the prevailing climate as well as on the general properties of the system itself. If we consider the noblest task of the highway engineer that of bringing good serviceable roads to the doorsteps of every citizen, then it is important to recognize these relationships and to make them the basis for continued research and progressive design. These considerations are of lesser importance when for high-density and heavy-traffic roads it is economically feasible to separate the pavement from the soil proper by a thick base structure of predominantly granular character. However, such high-priced roads

can for economic reasons comprise only a small percentage of the total road mileage of a country.

After these general considerations it seems worthwhile to consider some specific aspects of the deterioration of highway structures by climatic factors. The two most important are the variations in temperature and in moisture content. Their effect is evident in all parts of the highway from the soil substructure to the surface of the pavement. As far as the soil is concerned a small but cumulative loosening combined with moisture accumulation may finally lessen its bearing power to a degree at which it is no longer able to carry the stresses transmitted to it by the road superstructure.

The so-called flexible, or more correctly plastic, pavements usually remain in continuous intimate contact with the soil substructure. Thus, they are not able to bridge over weak spots in the soil—as a rigid pavement does—but are more sensitive to non-uniformity and low values of bearing power. On the other hand, if a flexible pavement is properly designed and, especially, if it is protected during the spring thaw by control of traffic loads, the loosening effect of climate may be halted and even reversed by the continuous compacting effort of traffic. This is the main reason why flexible roads often deteriorate worse without than with traffic. The loosening action of climate is not confined to any particular temperature range but it is most severe if the fluctuations involve freezing, i.e., temperatures between 32° and −10° F. A very dramatic exhibition of this action of climate is the formation of thick ice lenses underneath a pavement caused by a certain combination of soil, frost, and water supply conditions. These formations often bulge the overlying pavement several feet above the original grade. During thawing, the ice lens becomes free water which cannot drain through the still frozen subsoil; this results in an over-saturated loose soil or what might be more properly described as a quagmire. A similar quagmire problem is encountered during summer in regions of eternally frozen subsoils. Thawing of the surface soil and inability of the free water to drain away may make a large quagmire of an entire region. This is a very important problem for highway and airport construction and for maintenance in the arctic regions. Both the Soviet and the U. S. armed forces have given serious attention to this problem.

Because of the importance of temperature fluctuations and gradients in highway pavements and substructures, their cause and means of transmission should be well understood by everyone interested in highways. The temperature on the surface of a pavement results from the direct or indirect absorption of radiant solar energy.

WESTINGHOUSE PHOTO

DIRECT HEADLIGHT ILLUMINATION

When seeing by direct headlamp illumination, the driver may be dangerously close to the obstruction before becoming aware of it.

WESTINGHOUSE PHOTO

SEEING BY SILHOUETTE

This is regarded as the customary condition of good highway lighting, especially for long ranges.

WESTINGHOUSE PHOTO

GLINT LIGHTING, IN LINE

Glint helps the direct lighting, especially if the reflections are in the line of driving.

WESTINGHOUSE PHOTO

LESS EFFECTIVE GLINT LIGHTING

Glint lighting is usually ineffective if the overhead light sources are not substantially in the line of the traffic lane.

The amount of such energy absorbed per unit surface and the surface temperature reached depends on the absorption power of the surface and the heat conductivity and heat capacity of the underlying layers. Black pavements become hotter in daytime and colder at nighttime than light-colored pavements. Daily and seasonal fluctuations in radiant energy received result in temperature fluctuations which are transmitted downward as waves of rapidly dampened amplitudes. The transmission phenomena may be considered as a superimposition of daily and yearly temperature waves. For normal fluctuations in surface temperatures the amplitude of the daily wave is still measurable at depths of one and one-half feet, that of the yearly wave at a depth of twenty-five. At these depths, which represent about one-half of the length of the respective temperature waves, the lowest temperature occurs at a time when the surface temperature is at a maximum. This phenomenon, often surprising to the uninitiated, has been utilized by primitive peoples from time immemorial.

In plastic systems such as soil and flexible pavements, every constituent particle acts more or less as an independent unit; hence, in such systems, the destructive action of temperature fluctuations decreases rapidly with increasing depth. In a rigid structure, such as a concrete pavement, all constituent particles act in unison. Here, the temperature differences between the top and the bottom of the slab are of greatest importance. These differences lead to different thermal expansion and contraction on the two faces and throughout the body of the pavement, causing a downward curling during the daytime and an upward curling during the nighttime. Part of the pavement thus loses the support of the soil and may be crushed by excessive traffic loads. In addition, the almost continuous internal stresses cause a slow but certain internal disintegration.

Changes in moisture content cause stresses similar to those originating from changes in temperature. Again, the detrimental effect is due not so much to the average moisture level but to the amplitude and frequency of the fluctuations. The moisture and temperature effects are superimposed, intensifying or weakening each other. There seems to exist a frequency below which the destructive action of both temperature and moisture fluctuations decreases because of slowness of change, and above which the fluctuations degrade into a skin effect.

The severity of a climate with respect to its destructive effect on highways can easily be estimated from the amplitude and frequency of the prevailing temperature and moisture fluctuations. This concept of severity does not necessarily coincide with severity

judged from the point of view of human comfort. Economically, great destructive action of climate indicates the necessity for more expensive roads because it calls for stronger and thicker pavements and substructures. By the same token mild maritime climates combined with availability of granular materials may render it easy for a highway engineer to build up a reputation as an economical designer. Unfortunately, this reputation may be lost as the result of one abnormally severe winter; on the other hand the heroic fight of an able highway engineer against the never-ceasing attack by climatic forces may fall short of victory if the funds available are too restricted, and his reward will be undeserved blame and vituperation. It is obvious from these considerations that highway experience attained under one particular set of climatic conditions cannot be transferred to a different climate. This fact should be emphasized.

Having outlined the general philosophy of the relations between climate and highways which should be of greatest interest to the highway designer and administrator, it seems desirable to discuss a few specific effects of the differential element of climate, namely the weather. These effects pertain mostly, though not exclusively, to the field of the construction and maintenance engineer. The term weather refers to the state of the air or atmosphere with respect to heat or cold, wetness or dryness, calm or storm, clearness or cloudiness, or any other meteorological phenomena. It is obvious that these states affect highway construction, maintenance, and service in many respects. Construction activities are greatly hampered or made impossible by unsuitable weather. Very low temperatures make work impossible by their effect on human beings, machinery, and materials. Concrete should not be placed below 42°F because of freezing danger and the retarding effect of low temperatures on the setting and curing; bituminous materials lose their flow properties and their aggregate covering power; soils cannot be compacted to greatest desirable densities at low temperatures. For these reasons, highway construction is a seasonal industry and the work should be done at the most favorable time between the last frost in spring and the first frost in fall. Very helpful to contractors, especially if they plan to work on new locations, are statistical data on the dates of first and last frosts and on other meteorological phenomena; such data are obtainable from weather bureaus and other government agencies.

Sunshine and dry weather are welcome in highway work especially in bituminous construction. However, too much of it, and the resulting high temperatures may drastically interfere with the ef-

ficiency of the workers and supervisors. Also, hot dry weather calls for special care in the proper curing of concrete.

Precipitation interrupts construction work, especially with Portland cement and bituminous materials. Also, by increasing the moisture content of the soil it may cause considerable delay before the latter is dried sufficiently to allow compaction to the design density and bearing power. Some climates, for example that of southern California, possess long and well defined periods during the year in which precipitation is absent. This is an ideal situation for economic road construction. In other climates, precipitation may be scattered non-uniformly throughout the year and construction methods depending on limited moisture contents of the soil materials represent serious economic liabilities. In such cases, other methods, though calling for higher-priced materials, must be chosen to avoid excessive risks by the contractor or excessive costs to the building authority. A case in point is the preference for rolled earth fills in the drier climates of the Middle Western regions of the United States and that of hydraulic fills in the more humid eastern regions.

Rainfall is also the cause of sheet erosion and gully formation, a serious problem for the maintenance engineer who inherits all the ills caused by faulty design and construction. Similarly as in the over-all climatic action, it is not the total rainfall per year which indicates the seriousness of the erosion problem; rather it is the rainfall pattern. Especially destructive are torrential rains after severe dry spells.

Proper drainage is justly considered as the most important single factor in highway performance. Adequate design of drainage installations requires the knowledge of such climatic data as precipitation pattern, infiltration, run-off, surface retention, evaporation, and stream flow. The basic data on these phenomena for particular locations can usually be obtained from government agencies.

An important feature of maintenance is the removal of snow from highway pavements. Because of the seasonal character of this activity it is good engineering to employ equipment, especially tractors, of a character which permits its utilization for other maintenance or construction purposes during the snow-free season of the year. Where traffic is light and where cold temperatures continue for a considerable time, it is good practice to use the compacted snow as a road surface. By its insulating properties the compacted snow protects the highway pavement from the effect of severe temperatures. A point to be considered in this connection is that removal of snow from a pavement but not from the neighboring soil

results in a lower temperature of the soil underneath the pavement as compared with that of the soil on the sides of the road. This brings about a flow potential for the soil moisture with consequent moisture accumulation—often in the form of ice layers—underneath the pavement, expressing itself in frost heave and frost boils or generally lowered bearing power of the road after the spring thaw.

The speed of a road is limited not only by its width and alignment but also by the absolute sight distance and by the physical condition of the road surface. These latter are seriously affected by such climatic factors as fog, rain, snow, hail, and ice formation on road and windshield.

Attempt has been made here to trace a general picture of the influence of climate on highways. Specific details have been avoided or presented only as they seemed necessary to show the close connection of the more or less abstract general philosophy with the direct observations easily made by the engineer and the layman. Already, progressive contractors and highway departments are using climatic records and weather information for the planning of their activities. This trend will undoubtedly continue. However, what seems most important to the author is this, that the general relationships between highways and climate should be better understood by those responsible for the planning and designing of our highways. Only by this understanding can we hope to approach the solution of our most challenging problem which is to provide truly low-cost all-weather roads to all citizens.

37 HIGHWAY SAFETY: THE CASE OF THE PEDESTRIAN, CYCLIST, AND HORSE-DRAWN VEHICLE

BY RICHARD O. BENNETT

ALTHOUGH our modern American streets and highways were designed primarily to provide for the expeditious and safe movement of motorized vehicles, the governmental agencies who built these travelways did not, with a few rare exceptions, grant to motorists an exclusive franchise. Our streets and highways must be shared. They must be available to pedestrians, bicyclists, and drivers of horse-drawn vehicles as well as to motorists. These "other users" have inalienable rights which cannot be denied. They must be provided with the same freedom of movement and safety, within regulations, as our motorized travelers have learned to expect through years of pampering.

Because of inherent differences in the various types of traffic on the road, involving such items as weight, size, speed, maneuverability, and numerical strength, the sharing of our highways is never on an equal basis. Attempts to safeguard the lives and limbs of our publicway travelers, both afoot and mounted, have evolved into efforts to protect one from the other. To some degree this has been accomplished through segregation, education, and enforcement, but the problem is far from licked.

No panacea for road safety has been developed, despite sincere efforts by some of the best minds in America; nor will there be such a panacea. Our traffic ills are intangible. They cannot be isolated, like a tuberculosis germ, and thus destroyed. While our traffic problems involve machines and are the direct by-products of the machine age, no corrective treatment of the machines themselves can eliminate the havoc they are daily causing, or even a major portion thereof. Those dealing with the prevention of traffic accidents are confronted with a tangled maze, involving human nature, emotion, deficiency, error, judgment, and habit, plus inherent rights, legal technicalities, the elements, phenomena of nature, man-made machines and devices with great potentialities and limitations, and a great many situations and conditions which do not conform to any prearranged pattern or control measure.

Accident prevention to the greatest possible degree cannot come

through the efforts of the traffic police alone, nor solely from the efforts of the educator, the engineer, the judiciary, the legislator, the psychologist, or any one of the other professions directly or indirectly concerned with the problem. It can come only through the joint and cooperative efforts of all of these, with unreserved assistance of the great majority of Americans who consider themselves good citizens.

The modern automobile driver resents the presence on the streets of horse-drawn vehicles, bicycles, and pedestrians, despite the fact that he may have been a driver of a horse-drawn vehicle, undoubtedly was a bicycle rider, and definitely is a pedestrian whenever he finds himself on the street sans motor vehicle. He considers these with whom he must share the road as monkey wrenches in the wheels of his progress, bunkers on the clear fairways that make up our highway system. Despite his resentment, the motorist must tolerate the walker, the cyclist, and the wagon. Not only must he tolerate them, he must learn to cooperate with them, give way to them, and help make it possible for them to go their ways in safety. They cannot be removed from the highway as an engineer would remove a hazardous obstruction.

In these United States there are $3\frac{1}{3}$ million miles of public improved and unimproved streets, roads, and highways, stretching from the crowded tenement areas of Manhattan to the wide expanses of the western plains. Attempting to use these roadways, besides some $43\frac{1}{2}$ million motor vehicles, are 130 million pedestrians, 18 million bicycles (as estimated by the Bicycle Institute of America, Inc.), and an undetermined number of horse-drawn vehicles. (The horse and mule population of the country was 15 million in 1940.) [1]

If an equal distribution of these many millions of highway users were possible, the problem would be trivial by comparison with that which exists today. But there is no equal distribution, nor can there be; and as a result we have a heavy concentration of motor vehicles, pedestrians, and bicycles, along with a few horse-drawn vehicles, in urban areas. This concentration has resulted in a conflict which has contributed mightily to the huge annual toll of traffic deaths and injuries in the nation.

In building a case for these three underdogs of the traffic world, it is well that they be considered singly, inasmuch as they are fundamentally different in spite of the fact that the laws of some municipalities and states consider a bicyclist a "mounted pedestrian" and a horse-and-wagon a "vehicle" in the same sense as an automobile.

[1] See "Transportation and War," an address by Chester Gray, Director, National Highway Users Conference.

Actually, a bicyclist is not a pedestrian-on-wheels and control measures designed for bicycles are not as a rule applicable to pedestrians and vice versa. A horse-drawn vehicle differs from an automobile or truck, inasmuch as it is not subject in most jurisdictions to licensing and cannot conform to rules provided for motorized traffic, i.e., headlights, brakes, warning devices, and minimum speed regulations.

THE CASE OF THE PEDESTRIAN

Walking has been a right and privilege of the human race since time immemorial. It has been only since the advent of self-propelled vehicles that society has seen fit to apply restraints to the pedestrian, and only then for his own protection. True, such things as sidewalks and street crossings preceded the automobile by many centuries, but these were conceived not as safeguards for the pedestrian, but for his personal convenience.

To drive an automobile a person must be of a certain age and must meet with certain other minimum physical standards that may be self or legislatively imposed. The driving of a motor vehicle is a privilege granted by government to those capable of doing so, and this privilege may be taken away for cause. How different this is from the status of the pedestrian. Anyone who has the physical ability to stand and to propel himself by taking steps is a pedestrian. It matters not if he has sight or hearing. It matters not if his progress is made through great physical effort and at an extremely slow pace. In other words, if he can transport himself, it is his privilege to do so. In a broad sense, all people are pedestrians and may use our public ways, except those who are so young that they have not yet learned the art of walking, those who are kept within the confines of institutions, and those unable to walk because of physical disabilities. Among pedestrians you find all motorists, all cyclists, and the users of most, if not all, other forms of transportation. Therefore, it can honestly be said that, in dealing with pedestrians, you are dealing with the people as a whole: the young and the old, the halt, the infirm, and the blind.

The pedestrian is the most difficult "problem child" of the accident-prevention movement. He is not subject to licensing, therefore, enforcement of regulatory measures for his protection is hampered. In the eyes of the general public, the violations he commits and the errors of judgment he makes are of a trivial nature, but the results of these violations and errors are frequently disastrous.

Of the thousands of people who lose their lives every year as the result of traffic accidents, one out of every three is a pedestrian. Be-

cause of the concentration of pedestrians and motor vehicle traffic on the streets of our cities and towns, the ratio is higher there than the national average. Of each five persons who die of traffic accidents in urban areas, three are pedestrians. In rural areas, pedestrian fatalities represent one-sixth of the total traffic death toll.

Pedestrian fatality records show the influence of other circumstances and conditions. More than half of all pedestrian deaths occur between 6:00 p.m. and midnight, with a particularly high rate in the early evening. The period of dusk is the most hazardous hour of the day for pedestrians. Age affects the likelihood of an injury accident proving fatal and, also, the rate of occurrence. More than half of the persons killed in traffic under 15 and over 65 years of age are pedestrians. Another interesting sidelight is the fact that two out of three pedestrians killed were committing violations or were engaged in some obviously unsafe act. Pedestrian behavior leaves much to be desired. Special studies show that, of the pedestrians killed in recent years who were eligible from an age standpoint to have drivers' licenses, only one or two of every ten were actually licensed operators, indicating that for the most part pedestrians involved in accidents with motor vehicles have little if any appreciation of the potentialities and limitations of motor vehicles.

In the foregoing are some of the facts which are known about pedestrian accidents; facts about when, how, why, and to whom they happen. Yet to be determined is how, through legislative action and other means, to instill in the pedestrian's mind that he must change his walking habits or become a casualty.

The pedestrian's chief benefactor is the engineer. By designing and developing well-conceived physical safeguards, the engineer is saving the pedestrian from many of his own follies. These engineering safeguards range from the simple application of paint on pavement surfaces, showing the pedestrian where he may walk in comparative safety, to huge and costly pedestrian tunnels and overpasses.

The question, "What engineering safeguards can be provided for the pedestrian?", can best be answered by illustrating what city, county, and state engineering departments are doing to meet the various critical conditions affecting the safety of pedestrians.

In rural areas where dangers to pedestrians are accentuated by high vehicle speeds, sidewalks have been built along highways, especially near cities and towns, schools, churches, community meeting places, industrial plants, and in transition zones between urban, suburban and rural areas.

One of the most commonly applied remedies for pedestrian protection is marked crosswalks, using yellow or white pavement paint,

metal discs, rows of differently colored bricks, and colored concrete. These not only show the pedestrian where to walk, but serve as a warning to motorists. Pedestrian-actuated traffic signals have been installed where they are warranted by the volume of pedestrian traffic and the conflict with vehicular traffic. Pedestrian "walk" and "wait" lights are a refinement of the standard traffic signals and are becoming increasingly popular.

Barriers for the control and direction of pedestrian movement have been used in many places with good results. They are of many types, some being simple iron railings and some single chains, while others are fence-like. They may be of permanent or temporary mounting.

Serving as places of refuge for pedestrians, safety zones and islands are installed where street widths and the volume and speed of vehicular traffic make street-crossing hazardous. The most effective are those which provide positive protection for the pedestrian. Traffic safety lighting has been found to be effective in the reduction in pedestrian accidents, as well as those of other types.

The adding of walkways to existing bridges and similar structures which must be used by both vehicles and pedestrians was one of the most important structural improvements for pedestrian protection.

Separation of pedestrian and vehicular traffic at grade is probably the most extreme structural change being employed to any extent to provide protection for pedestrian traffic. This involves the building of pedestrian overpasses and tunnels and requires heavy expenditures. Too frequently, however, pedestrians are reluctant to take advantage of this protection, preferring to risk their necks in the street itself.

There are various other methods for the physical protection of pedestrians, such as regulatory signs of various types.

Until comparatively recently the only accentuated approach to the pedestrian accident problem was through educational media. In recent years, however, engineering has made great strides and the police in a number of localities, fortified with enabling laws and ordinances, have been subjecting pedestrians to enforcement. Education, however, retains its place as an important means of attacking the problem and is a necessary adjunct to other means and remedies. In too many communities it has been the only approach, however.

Selective education projects, directed for example at a particular type of violation, or at a racial or nationality group, or at persons of a certain age, must grow out of an adequate and comprehensive accident-reporting system and complete analysis of pedestrian accidents.

Pedestrians must be educated as to where and how to walk, and shown how to recognize and avoid unsafe practices. They must be told how to take advantage of the many safeguards provided for their protection. Parents and teachers must learn how to instruct children in walking safely. For the protection of pedestrians, motorists must be instructed on pedestrian rights, and where and how to watch out for careless pedestrians, and how to cooperate to save pedestrian lives.

Media available for pedestrian education include publicity outlets, such as newspapers and radio stations, painted instructions on sidewalks and street surfaces, posters, billboards, show window displays, handout pamphlets, envelope enclosures, moving pictures, sound-slidefilms, contests, special pedestrian campaigns, "safety weeks," schools for pedestrian violators, and a variety of others.

The enforcement by police officers of pedestrian regulations, which until quite recently has been reluctantly and timidly attempted in only a few far-separated municipalities, is now an accomplished fact in many cities, large and small, throughout the nation. The acceptance by the public of pedestrian enforcement has been good wherever put into effect and the saving of life and limb has been remarkable.

As an indication of the growing trend toward enforcement of pedestrian traffic regulations, 11 per cent of all the cities submitting entries in the 1948 National Traffic Safety Contest reported arrests for pedestrian traffic violations, other than for public intoxication. Practically all cities either arrest intoxicated pedestrians or hold them in "protective custody" until sober. The need for this latter action is shown by the fact that, according to national traffic authorities, during 1948 17 per cent of drivers involved in fatal accidents and 23 per cent of pedestrians killed in traffic accidents had been drinking.

There seems little possibility of making substantial reductions in traffic deaths and injuries unless there is a general recognition of the important place the pedestrian occupies in the total traffic problem and unless the pedestrian assumes some of the responsibility for his own safety. He can do this by complying with existing regulations, which for the most part are designed primarily for his protection.

THE CASE OF THE CYCLIST

The bicyclist occupies a unique spot in the traffic control picture. In the first place, he represents a small minority among those vying for the use of our streets. In the second place, he is, for the most

part, of tender years and as such subject to parental and school discipline, rather than that meted out in a traffic courtroom. And third, he leads a sort of a will-o'-the-wisp existence, unwanted on the sidewalk and crowded from the street. Unlike the pedestrian, in only rare instances in this country though frequently abroad has the bicyclist been provided with special walks or paths.

Efforts have been made, both on state and municipal levels, to regulate and to control the use of bicycles. By and large these efforts have been successful in accomplishing their intended goals. The primary objective of these efforts, aside from reduction of bicycle accidents, was to bring home to the cyclist that he, too, has responsibilities to other users of the street and that he, too, must make contributions to his own well-being and safety.

Because it is the children who are riding our bicycles and because, being children, they do not receive consideration and a voice in determining their own rights and privileges, it behooves the rest of us to look out for their best interest.

Bicycle accidents account for their proportionate share of traffic fatalities and injuries. Every year for the past ten years approximately 500 bicycle riders have died in traffic accidents in the United States. The high point was in 1941 when 910 cyclists were killed in traffic.

The one thing that brings the importance of the bicycle accident problem forcibly home to those concerned with accident prevention is the fact that 70 per cent of those killed each year are 14 years old or younger, and that 84 per cent are less than 25 years old.

Like the pedestrian, the bicyclist is his own worst enemy. Special studies have demonstrated that two out of every three bicyclists injured or killed in traffic accidents were violating a traffic law at the time of the accident. One out of five bicycles ridden in these accidents studied was defective.

It is the educator and the enforcement officer who can do the most toward safeguarding the bicyclist. Aside from a few isolated instances where bicycle paths were installed, the highway engineers have done very little to bring safety to the cyclist; and it is doubtful if there is much they can do.

City after city has demonstrated that the number of bicycle accidents can be reduced by a well-rounded program of accident analysis, education, safety legislation, and enforcement. These measures are interdependent. Analysis of accidents will prove valuable only if used in an educational and enforcement program. Legislation without education and enforcement is just so much wasted effort.

The registration and licensing of bicycles are generally accepted

as a strong link between the cyclist and his safety. Such legislation takes cycling out of the "right to ride" class and puts it into the "privilege to ride" class. When it is properly administered, a juvenile bicyclist gets, along with his license plate, a deep realization that he has suddenly become a part of the great scheme of things; that he has become someone of importance with responsibilities and obligations. Many cities, large and small, have literally "cashed in" on bicycle registration as a means of familiarizing the rider not only with the bicycle regulations but also with traffic regulations generally.

Because a majority of all bicycle riders are of elementary and high school age, the school systems afford an excellent medium for bicycle safety education. Many school officials have more or less assumed the obligation for the safeguarding of their cycling pupils. Experience has proved that schools generally are willing and anxious to cooperate with other agencies in matters pertaining to bicycle safety.

Many of the educational suggestions contained herein for pedestrians are equally applicable to cyclists. To these suggestions might be added such things as bicycle safety parades, bicycle field days, bicycle-riding skill tests, and various safe-riding contests. Much literature and many posters are available which were designed to appeal to bike riders. Parents must be educated as well as cyclists, because cooperative parents can do much to surround their bicycle-riding offspring with safeguards against accidents.

Until they can be "sold" on the importance and necessity of enforcing regulations against bicycle riders, police officers manifest a reluctance to take action. This condition shows a need for another type of education; that of our enforcement officials in the need for bicycle safety. Irrespective of age, cyclists must be required to comply with all regulations designed to promote safety. This enforcement must come from the police. Because no one wants to "throw" youngsters into an adult traffic court, and because most traffic judges have no jurisdiction over juvenile offenders, special provisions have been made in some localities.

Most common is the extra-legal practice of suspending bicycle licenses for stated periods for reported violations, after informal hearings with the parents in attendance. These suspensions usually are the result of an agreement between parents and the police. Another effective procedure is the extra-legal special Saturday morning juvenile traffic court with a police judge, sympathetic to the problem, presiding. Some police departments report juvenile bicycle violations to the parents and/or school officials. These are only a few

of the many means of applying discipline to the child offenders, without getting involved in legal technicalities.

Of extreme importance is the matter of safe bicycles. Many agencies recommend that bicycles be relicensed each year and that only those bicycles which can pass rigid inspections by competent examiners be licensed. Not only is it important that the bicycle be in a safe condition, but it must fit the rider and not be too large, too small, or improperly adjusted.

THE CASE OF THE HORSE-DRAWN VEHICLE

As America has worked its way out of what has been termed our "horse-and-buggy economy" into the present era of high-speed mass-production, the importance of the horse as a factor in our national life has decreased. Most farmers, who once depended upon the ox, the mule, and the horse to provide the needed energy, have turned through economic necessity from hay-burners to gas-burners.

The horse-drawn vehicle, which in grandfather's day was one of our chief means of transportation, no longer makes a contribution worthy of mention. It has been rendered ineffective and obsolete. To approximately the same degree, the horse-drawn vehicle is no longer a serious threat to the safety of other users of highways.

Little is known about the number of animal-drawn vehicles in service today. It is known, however, that many domestic supply companies, such as dairies, ice and fuel distributors, fruit peddlers, and brewers have found it expedient to retain animal-drawn vehicles for door-to-door deliveries in densely populated urban areas. Some farmers with prejudices against motorized equipment or for economic reasons still depend on wagons and horses to transport farm products and for other purposes.

The country's horse and mule population, estimated in 1940 at 15 millions, is distributed throughout the country and is serving many uses. Included are the army's pack mules, the harness and running horses of race fanciers, the cow ponies, high school show horses, saddle horses of riding enthusiasts, farm animals, and the like which seldom are exposed to traffic dangers on public streets and highways. The others are hitched to lumbering wagons and are more of a traffic obstruction to be avoided than a death-dealing force.

It is most fortunate in this era of high speeds and traffic congestion that the number of animal-drawn vehicles has diminished to this extent. Were it not so, our traffic accident situation would be much aggravated.

Because accident-record statisticians do not segregate accidents involving animal-drawn vehicles from those involving ridden, herded

or unattended animals, it is not definitely known how many of our people lose their lives or suffer injuries as a result of collision between motor and animal-drawn vehicles. It is, however, safe to assume that these represent less than 1 per cent of the total national traffic toll. The total deaths from all traffic accidents involving animals average less than 150 a year, and a majority of these accidents take place in rural areas. Unquestionably, a large portion of these accidents involve unattended domestic and wild (i.e. deer) animals ranging along the highways.

It is interesting to note that during the years of World War II, there was a marked increase in the number of fatal accidents involving animals over the previous ten-year average. This increase was registered while fatalities resulting from accidents of other types showed a decided decrease, indicating that beasts of burden were utilized as wartime substitutes for motor vehicles.

There is still much which can, and should, be done to minimize even further the number of accidents involving horse-drawn vehicles. No such vehicle should ever be permitted on a street, highway, or rural road at night without sufficient lights, both fore and aft, to make it discernible to the operators of other and faster moving vehicles for a distance of at least 100 yards. Mirror-type reflectors are insufficient for this purpose. Such slow-moving vehicles, as are all those drawn by animals, should not be permitted on heavily traveled thoroughfares where they would interfere with the normal movement of motor vehicle traffic. Engineers should provide sufficiently wide shoulders or berms which can be used by animal-drawn vehicles. This should be done not only for safety's sake, but out of consideration for the animal's hoofs—and incidentally for the convenience of lug-tired tractors which are forbidden to use the highway.

The drivers of animal-drawn vehicles should be made aware that it is just as important that they keep their minds on their driving and their eyes on the road as it is for the motorists to do the same. Driving in the center or on the left side of highways has contributed to many serious traffic accidents. Drivers should not give the horse "his head." Horse sense is a wonderful thing but too much should not be expected of it. Animal-drawn vehicles must be subject to applicable traffic regulations in the interest of safety and the expeditious movement of our large traffic volumes.

Motorists must be educated to give consideration to animal-drawn vehicles. They must know, for example, that the sounding of a blaring automobile horn when close to a horse is a dangerous practice; that the days of frightened horses running away are not yet past. They must learn to give the right of way to saddle horses and to slow down

and cross bridle paths, deer paths, and cattle crossings with caution. They must be made to realize that unattended or herded animals on public highways and thoroughfares are potential causes of accidents; they must expect animals to do the unexpected.

BENEFACTORS

Assisting the various tax-supported agencies which are engaged in accident prevention activities—the police, the traffic and highway engineers, and the educators—are a number of large national organizations and local groups. Some of these are concerned with all phases of accident prevention, while others concentrate on single phases of the problem.

The National Safety Council, through its staff and committee members, has done much toward bringing safety to highway users as well as to workers in various fields of endeavor. Much light on the pedestrian accident problem resulted from the activities of the Council's Committee on Pedestrian Control and Protection, which is no longer active. This committee, composed of some forty recognized leaders in the traffic-accident prevention field, was ably assisted by other Council committees, such as the Committee on Traffic Accident Records, the Committee on Winter Driving Hazards, the Committee on Public Safety Education, and others. The Pedestrian Committee, among other things, developed the standard pedestrian control ordinance, which has been adopted by cities throughout the nation, and sound-slidefilms.

The American Automobile Association annually conducts a national contest in which cities and states vie for honors in pedestrian traffic-accident prevention programs and the results thereof. The A.A.A. also publishes much pedestrian safety literature and posters, sponsors school patrols, and holds clinics in the interest of pedestrian accident prevention.

Bicycle safety is being stimulated by several national organizations, including the National Commission for Traffic Safety of the National Education Association, and the Bicycle Institute of America, Inc.

As far as traffic safety is concerned, the animal-drawn vehicle has no organized benefactor.

Other national organizations concerned with the pedestrian problem are the American Association of Motor Vehicle Administrators, the International Association of Chiefs of Police, the American Association of State Highway Officials, the Institute of Traffic Engineers, and others. Several organizations have interested themselves in bicycle safety, including the Cycle Trades of America, Veterans

of Foreign Wars, and the National Congress of Parents and Teachers. Much constructive bicycle accident prevention work has been done by the National Safety Council's Committee on Bicycle Problems, which developed the standard bicycle registration and control ordinance which has been widely accepted and adopted.

The correspondingly little that has been done for the safety of horse-drawn vehicles and their drivers has come through the overall activities of such groups as the Farm Safety Division of the National Safety Council, the National Grange, and other organizations interested in safety on the farm.

38 AUTOMOTIVE SAFETY ON THE HIGHWAY

BY NORMAN DAMON

THE whole concept of traffic safety is based on the fact that accidents can be curtailed if hazardous conditions and actions are properly diagnosed and corrected. All lines of safety endeavor therefore converge on the three main elements of highway transportation—the vehicle, the roadway, and the road user. This section of the symposium primarily concerns their *causal* relation to the accident problem, and does not cover preventive measures [1] aimed at controlling the problem.

Invariably in any traffic accident a number of causes are involved. Darkness, rain, excessive speed, a narrow road, a blind intersection, a drinking driver or pedestrian, and wornout brakes—all these factors might be present in a single accident. Removal of any single factor might have prevented the accident.

There is, then, no single cause of traffic accidents and no single cure. Engineers must design vehicles and roads to be as safe as possible. Driver license and vehicle inspection officials, the police and courts and safety educational groups—all share in the responsibility for accident prevention. And finally, the road user must keep himself and his vehicle in proper condition for safe use of the roads, and adjust his actions to changing conditions as he proceeds along the highway.

In brief, effective accident prevention demands a balanced and comprehensive program based upon the two following fundamentals:

1. A recognition that the primary responsibility for traffic safety rests with those public officials who are charged by the law with the building and maintaining of roads and streets and the regulation of their use.

2. A recognition that these public officials cannot discharge this responsibility effectively without an articulate and informed public opinion in support of the official program.

SIZE AND QUALITY OF THE VEHICLE

Safe operation has always been a major objective of motor vehicle design. Inherent vehicle defects, as distinguished from defects due to

[1] These are most effectively summarized in the Action Program, President's Highway Safety Conference, May 1946.

careless maintenance, long ago ceased to be more than a minor factor in accidents.

All-steel bodies, safety glass, four-wheel hydraulic brakes, low-pressure tires, sealed-beam headlights, uniform driving controls, a lower center of vehicle gravity—these are but a few of the innumerable improvements which have made the modern motor vehicle safer, more comfortable, more trouble-free. Generally improvements made by one manufacturer are available to competitors under a patent pool maintained by the industry itself.

The passenger car has changed gradually from a cramped horseless carriage to a functional vehicle structurally and operationally arranged for safe and comfortable use. In width, the body grew to nearly six feet; in length to seventeen feet—with slight variations among makes and models. The smaller cars popular in Europe met with little interest in America before World War II, because good used cars could be bought for less than a new "midget" car.

With the materials used in 1918, the 1949 passenger car would have weighed 6,000 pounds—twice its actual weight—and would have cost twice as much to buy and operate. By technological progress and mass production, American manufacturers constantly gave a better car at the same—or lower—cost.

Commercial vehicles, responding similarly to market demands, grew in size and load capacity up to the limits imposed by the states to protect roads from damage, to provide safe passing margins in traffic, and to meet overhead clearance limits at bridges. Numerous vehicle types were developed to meet special needs efficiently—the truck-trailer, the passenger bus, the school bus, cab-over-engine units, and other special types for medical, fire, industrial and public utility use.

In 1946, the American Association of State Highway Officials adopted revised limits on vehicle size and weight and recommended their nationwide adoption. They are:

Vehicle width, 8 feet; height, 12½ feet; length of single truck, 35 feet; length of combinations, up to 60 feet. Gross weight depends on the number and spacing of axles.

Prior to World War II, seventeen states and fifteen cities enacted laws for regular inspection of motor vehicles. During the war these inspections were curtailed or suspended in many instances. Twelve of these states and most of these cities have now resumed their programs. However, adoption of vehicle-inspection laws continues to lag, despite the recognized need and value of official surveillance of vehicle condition.

Vehicle defects, due mainly to improper or inadequate main-

tenance, were contributory factors in about 6 per cent of fatal accidents in the years immediately before the war. During the war, with over-age cars and tires kept in use, and with difficulties in obtaining repair parts, this factor rose to 18 per cent. While automotive production the past three years has relieved the situation to some extent, the percentage of unsafe vehicles reported as contributing to fatal accidents is still double that of 1941.

Progress in motor vehicle design undoubtedly will continue to be evolutionary and to be governed by such factors as consumer demand and income, legislation, taxation, and to some extent by new highway developments. Research into improved safety features is constant—such items as polaroid headlights and special lights to indicate intended turning movements being studied for possible universal adoption.

DESIGN AND SURFACE TEXTURE OF ROADWAY

Since our most important roads and streets were improved earliest, they generally are the least adequate for today's traffic volumes and speeds, in terms of lane widths, grades, curves, and other modern engineering features for safe and efficient traffic movement.

In addition, the paving of a vast mileage of secondary roads and streets induced higher speeds than the roads were designed for. Thus, while the bulk of accidents are concentrated on a relatively small mileage of heavily traveled streets and highways, short sections of many lightly traveled routes also have unusually high accident rates, based on travel miles.

Because unusually high accident rates exist on certain short sections of roads and streets, there obviously is a relation between accidents and road design. Few states gather complete or adequate reports on accidents—reports showing exactly where and how the accidents occurred. Progress, therefore, has been slow in determining the effect of various road design features on accidents.

At the request of the National Interregional Highway Committee, headed by Commissioner Thomas H. MacDonald of the Bureau of Public Roads, the National Safety Council in 1945 began a special study of accidents in relation to road design for various traffic volumes on existing roads. A preliminary report has been published including data from ten states and covering 9,000 accidents that occurred on almost 4,000 miles of major rural highways. Among the significant findings were:

1. The accident rate on controlled-access divided highways is about 40 per cent lower than on 2-lane and 4-lane undivided highways. On 3-lane highways the rate is nearly 35 per cent higher.

2. On straight 2-lane highways the accident rate rises as traffic volume increases, until the volume reaches about 9,000 vehicles a day. At that point the rate suddenly declines, probably due to the effect of congestion and the resulting reduced speeds of operation.

3. Sharp curves tend to increase accident frequency. Curves that are infrequent are more hazardous than those that are part of a continuous winding alignment.

4. Pavement width has a marked bearing on accident rate. On straight two-lane highways, the accident rate per million vehicle miles is nearly twice as high on 18-foot pavements than on pavements from 22 to 24 feet.

Other studies conducted in California, Michigan, Connecticut, New Jersey, and Virginia have demonstrated the safety benefits of modern high-type construction. Expressways, with their "built-in"

TABLE A: HOW TRAFFIC FATALITIES OCCURRED IN 1948

		URBAN	RURAL
Total deaths		10,500	21,500
Collision with pedestrian			
Crossing at intersection		22%	2%
Crossing elsewhere		20	7
Walking in roadway		4	4
Other types		10	4
	TOTAL	56%	17%
Collision of motor vehicles			
At angle		13%	5%
Head-on or sideswipe		6	20
Rear-end or sideswipe		2	6
Other types		3	5
	TOTAL	24%	36%
Other roadway collisions			
Train		5%	3%
Street car		1	0
Other vehicle or animal		1	1
Fixed object		2	7
	TOTAL	9%	11%
No roadway collision			
Overturned		1%	4%
Ran off curve		2	9
Ran off straight road		3	16
Other type		5	7
	TOTAL	11%	36%

Source: National Safety Council

safety features, including controlled access, separation of opposing traffic streams and elimination of crossing at grade, have in some cases reduced accidents as much as 75 per cent. These refined design standards are being increasingly adopted for metropolitan arterial routes and rural trunklines where justified by heavy traffic volumes and high accident rates.

Table A, showing how traffic fatalities occur, makes clear certain differences in rural and urban accident experience. In cities, 56% of the victims are pedestrians, and the street intersection is the major focal point of both pedestrian and non-pedestrian deaths.

Where large traffic volumes exist, nothing less than the controlled-access expressway, without intersections or pedestrians, can provide a safe urban design. Moreover, the traditional checkerboard street pattern, spreading traffic haphazardly over neighborhood streets, is slowly being modified by adoption of coordinated arterial and land-access streets, different in design and layout to meet the needs of the extraordinary traffic density.

In rural areas, Table A shows that 72% of fatalities are due to two-vehicle collisions or to vehicles overturning or leaving the roadway out of control. Obviously many of these rural fatalities are related to poor design features such as lack of a safety margin in pavement width and limited vertical and horizontal sight-distances due to sharp curves and steep grades.

An intensive investigation by the Public Roads Administration some years ago revealed that on two-lane highways with 18-foot pavements and grass or gravel shoulders, 11 per cent of the trucks and 5 per cent of the passenger cars failed to keep on their side of the road in meeting oncoming traffic. Although authorities are agreed that, for safety, 22-foot pavements are necessary where only cars use the road, 24-foot where there is mixed car and truck traffic, and greater widths where commercial-vehicle volume is heavy, the fact remains that nearly 30 per cent of the primary highways of the nation are still less than 20 feet wide.

TABLE B: STATUS OF U. S. ROAD SURFACING

ROAD SYSTEMS	THOUSANDS OF MILES	PER CENT SURFACED	PER CENT HIGH TYPES *
State	550	82	27
County	2,459	42	2
Municipal	317	75	33
	3,326	50	9

* Bituminous, concrete, brick or block pavement.

Source: Bureau of Public Roads

Table B shows that half of our three and a third million miles of roads and streets have been surfaced to date, although only 9 per cent is high-type surfacing. A number of satisfactory concrete and bituminous non-skid surfaces now are widely used (see bibliography), but no surfacing can overcome slippery conditions resulting from ice, snow, wet leaves, mud, or oil on the pavement. Proper road maintenance procedures and winter driving practices, however, can reduce the resultant dangers materially.

Special studies (see bibliography) of winter driving hazards point to the value of tire chains and the importance of slow, careful driving on icy roads. The proportion of accidents involving skidding is only 1 per cent on dry roads, but as high as 27 per cent on snowy-icy roads. These hazards are multiplied by night driving during winter. Winter death rates, based on travel mileage, are about 40 per cent higher than summer rates in northern states.

A 1944 Michigan study indicates that gravel surfaces are more hazardous than high-type pavements—13.4 deaths per 100 million travel miles on gravel and 12.5 deaths on paved roads. But certain paved roads on secondary rural routes of poor engineering design—"high-speed surfaces on low-speed roads"—showed extremely high death rates. The study indicated further that on heavily traveled routes just outside large cities, where roadside commercial developments exist, even such features as wide divided roadways and good horizontal and vertical road alignment cannot in themselves prevent unduly high accident rates due to lack of control over roadside access and grade intersections.

Under the accelerated federal-state-local highway program which began shortly after the war's end, modernization is being stepped up not only on main urban and rural highways but on large mileages of secondary rural roads and urban trunkline extensions. Under the Federal Aid Program, too, special high design standards have been adopted for a new Interstate Highway System—a 40,000 mile national network of roads which carry the heaviest daily urban and rural traffic in America.

ILLUMINATION AND VISIBILITY

Three of every five fatal traffic accidents are at night, although only a third of all traffic moves at night. The death rate, based on travel miles, is three times as great at night as during the day. In cities, the death rate from 3:00 to 4:00 in the morning is ten times as high as between 9:00 and 10:00 in the morning—the latter period being the safest traffic hour.

Actually traffic accidents are more closely related to seasonal

changes in hours of darkness than they are to the wide variations in monthly travel miles. This is because pedestrian deaths, making up from 30 to 40 per cent of the annual fatalities, are almost entirely governed by seasonal variations in hours of darkness. Non-pedestrian deaths are more closely related to monthly variations in travel miles than to seasonal variations in hours of darkness.

Street and highway lighting is costly to install and operate, but properly used where night accident problems are severe, it is highly effective. However, the majority of older street lights have only slight value in traffic safety, since they fail to throw enough light on the roadway. Producing the equivalent of daylight conditions is not necessary in highway and street illumination. Rather, authorities say sufficient light should be cast on the roadway to create a background for "silhouette seeing."

There also is an indicated need for greater use of materials to reflect the motorist's headlights on traffic signs, pavement lane stripes, curve warnings, and on roadside "delineators" which outline the path of the road ahead. Many reflectorized signs and warning devices now used are too small or weak for quick reading, and they are not employed frequently enough. Both the quality and quantity of reflectorization can be expected to increase in the future.

MOTOR VEHICLE LIGHTS

The sealed-beam headlight, now universally used on new vehicles, was a major advance in vehicle lighting. Failure of many motorists to switch from the upper to the lower beam when meeting oncoming traffic causes annoying glare and occasionally results in accidents due to temporary blinding. Nationwide accident records do not indicate, however, that headlight glare is an important accident factor.

The automotive industry is conducting extensive research on polaroid lighting as a possible solution to the glare problem. This involves the use of special headlights and windshields which together eliminate glare while retaining full visibility factors. A number of technical, economic, and legislative problems are involved. For instance, there is the question of cost and procedure in converting to polaroid the 43 million motor vehicles now on the road. Some practical solution will have to be found whereby standard and polaroid lighting can be used together during the changeover period.

RESPONSIBILITY OF ROAD USERS

Although public officials have the primary responsibility to prevent accidents through building safe roads, requiring vehicles to be in

safe condition, through police and court enforcement of traffic laws, and through a sound program for driver license administration, a vast share of the responsibility for safety remains with the individual motorist and pedestrian.

They are required to know and obey traffic laws, keep their cars and themselves in proper condition for safe use of the highways, and exercise caution and judgment in meeting changing road and traffic conditions. They must recognize such handicaps as defective eyesight or fatigue, and use extra caution to compensate for such physical inadequacies.

Obviously, then, in the light of necessarily wide latitude for the exercise of individual judgment, it is essential to hold the individual driver and pedestrian accountable for his performance on the road. Enforcement of traffic regulations has two phases: first, civil responsibility for damages, which is being met to an increasing degree by financial responsibility laws in the states; and second, personal responsibility for law observance, backed by police and court action. Surveys have shown repeatedly that no police or court action is taken against driver or pedestrian in a comparatively high percentage of accidents where one or more violations are indicated. Until such charges are made in all cases where infractions are apparent, motorists and pedestrians will not be inclined to accept their individual responsibility for traffic safety.

The wide variation in accident rates among the states generally can be related to the caliber of official safety programs, and to success or failure in obtaining public support for preventive measures.

Because of the many factors involved here—driver licensing and vehicle inspection standards, police and court enforcement, driver training, the quality of roads and streets, and local driving customs—it is not possible to trace accident reductions to any single cause. But the evidence is clear that a vigorous and balanced safety program invariably generates a greater assumption of individual responsibility for safe use of the highways, with a resultant lowering of the accident rate.

BEHAVIOR OF ROAD USERS

Having noted that certain short sections of roads and streets have exceptionally high accident rates—conclusive proof that road deficiencies are one major factor in accidents—we come now to the even more significant fact that certain types of drivers are involved in far more accidents than can be accounted for by the law of averages.

Actually, according to the nation wide accident records tabulated by the National Safety Council each year, unsafe or illegal driving

actions are reported in two of every three fatal accidents. Similarly, two of every three pedestrians killed in traffic are found to have violated traffic laws or basic safety principles.

From analyses of comprehensive accident records in several states, two conclusions are outstanding. One is that the accident rate of drivers in the 18 to 24 year age group is at least 50 per cent higher than the general average. The second conclusion is that accident repeaters representing four per cent of all drivers account for 36 per cent of all accidents.

TABLE C: DRIVER ACTIONS IN FATAL ACCIDENTS, 1948

	URBAN	RURAL
No violations	39%	14%
Excessive speed	19	30
Not having right-of-way	15	6
Wrong side of road	3	12
Under influence of alcohol	4	12
Ignored traffic signs	6	5
Improper passing	2	5
Other violations	12	16

Source: National Safety Council

TABLE D: HOW PEDESTRIAN DEATHS OCCURRED, 1948

	URBAN	RURAL
Crossing at intersections		
With signal	6%	* %
Against signal	5	1
No traffic signal	25	7
Diagonally	4	1
Crossing between intersections	35	40
Walking in roadway	7	25
Other actions	18	26

* Less than one per cent

Source: National Safety Council

TABLE E: FACTORS IN FATAL ACCIDENTS, 1948

Night driving	55%
Improper driving (except speed)	50
Excessive speed	33
Driver drinking	17
Pedestrian drinking	25
Slippery roads	20
Vehicle defects	13
Weather cloudy, rainy, etc.	14

	URBAN	RURAL
Driver's vision obscured	17%	20%
Rain, snow, etc.	6	8
Trees, billboards, etc.	5	5
Other cars, headlights, sun glare, etc.	6	7
Physical handicap (except drinking) of driver or pedestrian: sleep, fatigue, defective eyesight, etc.	11	5
Road defects	7	9

Note: 64% of all pedestrians killed were committing unsafe actions.

Source: National Safety Council

Tables C and D show driver and pedestrian actions in fatal accidents of 1948. It is obvious that in most accidents at least *one driver* did commit a violation. Speed excessive for conditions (usually this meant driving too fast at night) was found in 30 per cent of rural fatalities, with drunken driving and driving on the wrong side of the road tying for second place as the most deadly faults. In urban areas, right-of-way violations ranked next to excessive speed.

The major pedestrian fault, both rural and urban, is crossing between intersections. The next most hazardous one, in rural areas, is walking on the wrong side of the road. In urban areas, a leading cause of pedestrian tragedy is crossing at an intersection which has no traffic signal. While legally the pedestrian may have the right of way in such instances, analysis of accident reports shows that a large percentage of deaths of this kind are due to lack of caution in exercising this legal right.

Table E, showing circumstances in fatal accidents, reveals that the factors most often present are, in order: night driving, improper driving other than speeding, excessive speed, driver or pedestrian drinking, and slippery roads. Road defects and skidding are seldom reported. However, a road defect in an accident report generally means some obvious fault in road maintenance such as a deep pothole in the pavement, and infrequently involves those elements of obsolete design which were treated earlier in this discussion.

It is significant that 75 per cent of both drinking and driver-asleep accidents are at night. A number of states which have made night driving studies find that few motorists practice the elementary safety principle of reducing their speeds at night, even when the road is very narrow.

A high percentage of fatal accidents appear to be due to the expectation of drivers that the pedestrian or other motorist will give up the right of way. Psychological studies of problem drivers (see bib-

liography) reveal such faults as lack of imagination to foresee the possible consequences of a dangerous action, emotional instability and a desire to "show-off"—all reflecting the failure to develop a mature attitude toward the responsibilities involved in using the highways.

A study made in Connecticut indicated that 95 *per cent* of all pedestrians killed in traffic had never had a driver's license and thus were less likely to know the problems their actions created for motorists. More than half of all pedestrian deaths are at night, caused chiefly by (a) assumption that the driver sees the pedestrian, and (b) intoxication.

In exploring the problem of improving driver and pedestrian behavior, one fact stands out. It is that in most states a scientific approach cannot be made at present because accident reporting is inadequate in these states. National Safety Council samplings indicate that while fatal accident totals may be complete, only about a third of injury accidents are reported. And in most states even fatal accident reports do not contain essential information on exactly where and how the accident happened.

It is estimated that more than a million young Americans annually become new drivers. Generally they have learned to drive from a member of the family or some other amateur instructor, or even without instruction. Potentially the best drivers because of good vision and reflexes, as a class they are the most dangerous because of poor training, lack of experience, and a tendency to "take chances." As they grow older and more experienced most of them become more cautious. But the ingrained habits of poor driving often remain.

Practical courses of driver training are now being offered in many high schools throughout the country. It has been demonstrated that the accident record of teen-age drivers who receive such instruction is at least 50 per cent better, on the average, than that of students who pick up their driving knowledge in hit-or-miss fashion. By the same token, it has been amply shown that effective training courses for commercial drivers also result in substantially better performance.

NEED FOR PUBLIC ACTION

The end of wartime restrictions on motoring brought an immediate resumption of the long-time trend of steadily increasing use of motor vehicles, which in 1941 had reached a peak of 34 million registrations. As traffic volumes soared back toward prewar levels, accidents climbed at a similar pace.

The nation's road plant had sadly deteriorated during the years of depression and war, and with the flood of additional traffic that was

bound to result as new cars became available, it was clear that a critical situation was brewing unless prompt action was taken to forestall it. The obvious need was for public and private agencies to remobilize and intensify the balanced program of accident prevention which in the five years preceding the war had materially reduced the traffic death rate.

In May 1946, the first President's Highway Safety Conference was held in Washington, D. C., attended by state and local officials and representatives of all private organizations interested in traffic safety. From the Conference came eight technical reports on all phases of safety activity and a recommended over-all Action Program.

Briefly, the reports urged such fundamental improvements as the adoption of uniform traffic laws; stepped-up enforcement by the police and the courts; upgrading of driver-licensing procedures; better methods of accident reporting and fuller use of accident records; roads and streets engineered for maximum safety; expanded programs for training teachers and traffic technicians; extension of safety education and driver training in the schools; and a vigorous and sustained campaign to inform the public of the accident problem and obtain public support for recommended safety activities.

These reports, embracing all the proven techniques of accident prevention tested in states and communities from coast to coast, have now become a balanced objective for state and local action on a nationwide scale. In 1948, the President's Conference developed the Annual Inventory of Traffic Safety Activities, which for the first time provides a reliable scorecard of progress, as well as a means whereby each state and city can annually appraise the strength and weakness of its individual program.

During the three years since the Action Program became operative throughout the United States, the national traffic fatality rate per 100 million vehicle miles has been pushed down from 11.3 deaths to 8—the lowest rate in history. This reduction represents a saving of some 11,000 lives, the prevention of at least 400,000 injuries, and an economic saving of nearly a billion dollars.

Another full-scale President's Conference was held in June, 1949, to reappraise the basic program. The eight technical reports were brought up-to-date, but the bedrock program was found fundamentally sound. For the third consecutive year it has been shown that the states and communities that have done the best job in protecting life and limb on their streets and highways are invariably those that are applying the recommended principles to the fullest extent.

For the immediate future, a redoubling of the organized safety effort will be imperative, if recent gains are to be maintained. Motor

vehicle registrations in 1949 are estimated at over 43 million—some nine million more than the prewar peak. Travel mileage has jumped 25 per cent, and it is an axiom that accident exposure increases with every extra mile. In view of these urgent realities, the challenge to government officials, civic groups, and the general public is, therefore, to "get more Action on the Action Program."

39 TRAFFIC OPERATIONS

BY D. GRANT MICKLE

THE rapid growth of street and highway traffic in America forced highway engineers to give first emphasis to the building of a vast mileage of road surfaces. Early speeds and traffic volumes were low, and traffic conflicts were met satisfactorily by a few traffic laws and the installation of an occasional traffic control sign.

Because of this initial construction program, traffic was able to expand. As gravel surfaces gave way to smooth pavements on important routes, faster, heavier, larger vehicles came into use. Between the two world wars, traffic rose 600 per cent.

With greater volumes and higher speeds, safe and convenient traffic operation was no longer a simple matter. Accidents, congestion, delays, and urban parking problems mounted alarmingly. Wide new roads—monumental examples of construction progress—frequently proved to be death traps and traffic bottlenecks. Frantic opening, widening, and paving of city streets, and installation of more stop signs and traffic lights, all too often simply made congestion worse and spread traffic over so large a mileage of city streets that all control of the accident problem was lost.

Gradually it became clear that traffic operation and control, and the design of roads to fit traffic requirements, were complex matters demanding special engineering study and full-time technical supervision.

In the early 1920's Ohio and several other states began assigning highway engineers to such work on a full-time basis. Chicago, Pittsburgh, and Seattle pioneered in city traffic engineering. The U. S. Public Roads Administration, now the Bureau of Public Roads, began fundamental traffic studies. Several universities undertook similar research.

From these activities developed proved techniques in traffic operation. In states and cities where they have been applied by trained personnel, substantial reduction in accidents and greatly improved traffic mobility have resulted.

A wider understanding and support for these measures is of growing importance as postwar traffic, accident and parking problems increase. Most authorities expect traffic by 1960 to be at least two-thirds over prewar peaks. In the planning and design of new traffic facilities, and in measures to improve the safety and efficiency of

existing roads and streets, traffic operation principles will be applied in the future on a scale far beyond any past experience.

IMPACT OF CONGESTION AND ACCIDENTS

Traffic studies carried out since 1935 by local, state, and Federal highway agencies show that motor travel—and congestion and accidents—are concentrated for the most part on a very limited mileage of main roads and streets that lead to major destinations.

Four of every five vehicles on all rural roads are headed for a city or coming from one. Traffic volumes rise only near cities, and reach a downtown peak averaging six times the suburban volume. This is caused by the addition of vastly greater local traffic to the incoming stream—plus the fact that lack of adequate urban routes forces many vehicles to pass through the congested downtown area to reach other local destinations.

The following table, based on nationwide state highway planning survey data, shows how traffic was distributed in 1940. By 1960 it can be expected that densities on main rural and urban routes will more than double, because main routes always gain a disproportionate share of any general traffic increase.

	% OF TOTAL MILEAGE	% OF TOTAL TRAFFIC	DAILY VEHICLES PER MILE
Main City Streets	1	20	5,400
Other City Streets	8	30	900
Main Rural Roads	10	36	900
Other Rural Roads	81	14	45

The gridiron city street pattern is the worst possible design for arterial routes that carry the heaviest traffic densities in America. Pedestrian conflicts, cross-traffic and turning movements, parking maneuvers, and the mixing of private, commercial, and transit vehicles make congestion and accidents inevitable.

In New York City, prewar congestion costs were put at a million dollars a day. A prewar Boston study showed congested streets cost motorists $18,000 yearly per mile in wasted gasoline alone. Detroit's 1940 accident loss was found to be $10 million, with an equal loss from traffic congestion.

The bulk of rural accidents are on relatively small sections of main trunk lines where particularly hazardous conditions exist. Remaining accidents are spread over a vast mileage of lightly traveled routes. Frequently they cannot be related to road or traffic conditions to an extent sufficient to justify special engineering measures.

Obviously, engineering remedies must begin on sections with high

accident rates. Moreover, they can never hope to eliminate the need for safe driving practices and police enforcement.

Much of our main road mileage was built for 35-mile speeds and for traffic volumes far below those of today—and of tomorrow. In width, sight distances, grades, and curves; in lack of roadside access control, modern traffic signs, and pavement markings and other traffic engineering features, a substantial rural mileage is operationally unsafe.

Particularly on sections approaching urban areas, where the transition from rural to urban driving problems often takes place before motorists are aware of it, do we find acute accident concentrations and congestion.

PLANNING NEW FACILITIES

A new Federal-state-local highway construction program, put into effect at the close of World War II, provides for long-range modernization of urban arterials and primary rural trunk lines, and for hundreds of thousands of miles of farm road surfacing.

The rural program eventually will include all roads of any general traffic significance. But the new urban arterials, even after years of construction, cannot hope to handle more than about 20 per cent of urban traffic movement.

To handle large traffic densities, the controlled-access expressway design has been developed. Records in several areas where such highways exist show that expressways can carry *on each traffic lane* as many vehicles per hour (1,500) as can the ordinary wide city street—and can carry traffic without interruption of flow and with safety up to 75 per cent better than ordinary streets.

Engineers skilled in traffic operation principles must review these and other road designs before construction begins, if they are to have the maximum "built in" safety and freedom from congestion—particularly as to the design of their access lanes, bridge piers, traffic control signs, and their methods for keeping disabled vehicles from parking on the traffic lanes.

The Gulf Freeway in Houston, Texas, offers a striking example of the benefits to be derived from modern controlled-access design. The first section of this facility, which will connect Houston and Galveston, has been completed and it is estimated that the monetary value of time savings to motorists will amount to nearly $2,700,000 annually. In addition, records show that most of the property along the Freeway has already increased from 200 to 300 per cent in value.

It should be pointed out that these new free-flowing arterials induce constantly heavier volumes of traffic, which our cities will not

FRIED-LEDER PHOTO

JUNCTION OF HUTCHINSON RIVER AND CROSS COUNTY PARKWAYS

Westchester County, New York, has long been famous for its parkways which carry the bulk of the motor traffic north and east from New York City.

PUBLIC ROADS ADMINISTRATION

EASTERN STATE PARKWAY, DUTCHESS COUNTY, NEW YORK

The wide median strip between opposing lanes of traffic eliminates cross glare of headlights. Construction on different levels reduces the height of cuts and fills, and makes it possible to fit the road into the topography without leaving scars on the roadside.

PUBLIC ROADS ADMINISTRATION

A PARKWAY SAFETY FEATURE

A strip of plant-mixed bituminous pavement with coarse aggregate serves as a transition between the turf shoulder and the concrete. Motorists are warned that they are leaving the pavement by the sound of tires on this "blacktop." Note the clean edge of healthy turf and the absence of the rut commonly found along traffic lanes less than twelve feet wide.

PUBLIC ROADS ADMINISTRATION

MODERN PRACTICES IN ROADBUILDING
An illustration based on U.S. 90 in Florida

NEW JERSEY HIGHWAY DEPARTMENT

TRAFFIC CIRCLE AT FREEHOLD, NEW JERSEY

This large oval, with easy curvature, expeditiously handles traffic approaching from five directions.

be able to handle unless they take comparable steps to make better use of the existing street plant—including improvement of parking conditions. A variety of useful traffic-engineering measures which have been successfully used to increase local street efficiency is discussed further on in this essay.

TRAFFIC RESEARCH

A new type of traffic origin-destination survey now is widely used to determine the proper design and location for free-flowing major urban arteries, including expressways. These surveys cover all forms of urban transportation, including transit vehicles, and provide the starting point for a comprehensive improvement of local traffic facilities.

The surveys show that both local and outside traffic—the latter usually averaging about 10 per cent of the local volume—is headed for the same general destinations inside town, in almost equal percentages.

The downtown area generally is the destination of nearly a quarter of total traffic. Destinations beyond the city may attract 10 to 20 per cent, and the remaining portion of local and outside traffic is headed for various other sections inside town. Lack of adequate urban routes forces *twice as many* local and outside vehicles to pass through the cramped downtown area as intend to stop there.

These surveys confirm the importance of three types of arterials for large cities. They are (a) a loop around the downtown fringe and another around the urban outskirts; (b) "spoke" routes connecting the inner and outer loops, and (c) crosstown routes, east-west and north-south, roughly a mile apart.

Such an arterial plan permits traffic to reach any part of town with a minimum use of local streets, and to bypass the downtown or total urban area if it wishes. Smaller cities require a less complete arterial plan, but even the smallest town needs both a through and a bypass arterial.

Special traffic studies also are necessary for the solution of the downtown parking problem. A 1946 Baltimore study, for instance, showed that while the downtown area had a critical shortage of parking spaces, certain downtown sections actually had more parking facilities than were needed—and other sections had special needs for all-day or shopper parking.

Proposals for huge downtown parking structures were found from the study to be impractical. They would serve only a limited area, since motorists refuse to walk far after parking. A number of small parking facilities, located on a basis of area need and with parking

rates and time limits to suit particular demands—these were found to be key elements of a proper parking solution.

Other new facilities needed in most cities are consolidated truck and bus terminals and off-street loading provisions. Urban expressways must include provision for their use by mass transit vehicles, with special stopping lanes for passenger pick-up.

In rural areas, the development of "high-speed pavements on low-speed roads" would only aggravate the accident problem. In matters of roadside access, highway geometry, traffic signs and markings and other elements affecting operating safety and capacity, trained technicians must pass judgment.

In the words of Commissioner Thomas H. MacDonald of the U. S. Bureau of Public Roads, "Just as the testing engineer passes on the adequacy of materials, so must the traffic engineer pass on the adequacy of the completed plans as a proper design for the traffic that is anticipated will move over the completed highway."

IMPROVING EXISTING FACILITIES

Three points concerning methods for improving traffic operations on existing roads and streets need particular stress. They are:

1. Accidents, delays and congestion *can* be reduced to an amazing degree through application of legal and physical controls over road and street use.

2. Most of these controls involve drawbacks as well as advantages, in that they restrict certain road uses. Unless the local public understands the need for these restrictions, the program may fail through public resistance and widespread disobedience of the regulations. Expert study is required to determine to what extent the regulations *are needed* locally—and whether the advantages outweigh the disadvantages.

3. Application of these controls by persons unfamiliar with traffic operating principles, and without expert local study, generally results in worse problems than before.

For instance, traffic movement can be improved by cutting back a curb at a street intersection, so turning movements can be made faster. But if there is heavy pedestrian movement at this intersection, the faster turns may create new hazards.

Again, in the seemingly simple matter of installing a stop sign at an intersection, we may reduce accidents at that point but cause traffic to seek other routes to avoid the stop sign—and thus create new problems at many other intersections.

These are simple illustrations, but other examples may be more complex. Each proposed control must be studied as to problems it

may create elsewhere, and an expert judgment must be made locally on whether advantages outweigh drawbacks, and whether the community is ready to accept the controls in full, or whether the changes must be made gradually to win public acceptance.

As traffic continues to increase, the need for more restrictions on certain traffic and pedestrian movements becomes more acute. Following is a brief discussion of ten major traffic engineering activities, to indicate something of the methods and scope of the operation.

1. *Collection and Analysis of Basic Data.* This is fundamental to all traffic operations work. Accident records must be gathered to learn where, how, and at what hours, accidents occur. Special field studies must be carried out, to find where traffic is going, in what volumes, and where and why delays occur.

Analysis of these data, and application of the proper engineering remedy, is a highly technical operation. But the studies have wide usefulness even beyond providing the traffic engineer with the information needed for obtaining maximum safety and efficiency from existing roads and streets.

For instance, the data show police what violations are causing most accidents locally and where to watch particularly for violations. They permit local safety campaigns to aim at the real causes of local accidents. They show whether drivers are poorly trained locally, or ignorant of the traffic rules—whether drunken driving, or some special age group, needs particular attention.

2. *Traffic Routing.* This has several phases. The first need is for a network of arterial streets on which *traffic movement* is given preference. Stop signs at side streets, one-way streets, intersection underpasses or overpasses, and the express highway design, all are methods for encouraging traffic to concentrate on arterial routes.

Until this arterial system is established, the basis for orderly traffic regulation is absent. Too often, arterial flow is discouraged by lack of an over-all arterial plan implemented by devices for favoring traffic movement.

One-way streets can carry vastly more traffic per lane than two-way streets, and with substantial reduction in delays and accidents. They will be used increasingly in the future. Because intersection-turning conflicts are much fewer on one-way streets, traffic flows steadily, and traffic lights can be timed for continuous movement. Curb parking is more easily retained on one-way streets, and pedestrians have only one direction to watch in crossing the street. When properly applied, the one-way principle invariably becomes popular with merchants and motorists alike.

Another important phase of routing involves the setting aside of

special routes or traffic lanes for transit vehicles and trucks. Still another involves methods to *discourage* heavy traffic on neighborhood streets, through use of frequent stop signs, low speed limits, and street layouts which stress the dead-end and winding type of route.

3. *Speed Zoning*. This involves the posting of rural and urban speed limits in accord with scientific determination of safe speeds for the particular section. Zoning is the proper application of speed limits. It encourages better obedience and more safety than a flat limit.

There is scientific proof that high speeds should not be permitted at night. The practice is growing of posting safe speeds on rural warning signs at curves.

A good illustration of the value of speed posting on curves is shown on Indiana State Route 37, where there are 200 curves in a 97-mile stretch. After engineering studies, safe curve speeds were posted. The previous year, seven deaths and 33 per cent of all accidents along the route had occurred on the curves. In the year following, there were no deaths, and accidents on the curves were only 15 per cent of the total—in spite of a substantial increase in traffic. The estimated savings in accident costs was $78,000.

4. *Turning Regulations*. The left turn cuts seriously into the capacity and safety of a heavily traveled route. Several large cities now ban left turns entirely on some major arteries, and find delays and accidents drop materially. *Where it is needed,* this ban invariably becomes popular with motorists after it is given a trial. It will be needed more and more in the future, particularly during morning and evening rush hours.

The right turn causes fewer traffic conflicts but requires control where heavy pedestrian movements exist. Right turns often must be banned on certain downtown streets. A traffic light with extra cycles, and green arrows, for turning movements; and the provision of special lanes in which vehicles wait for the turning signal, are proving effective in many cities.

One device which is bound to be used eventually is that of providing a raised barrier along the centerline of a main street, to prevent left turns and cross-traffic movement at minor intersections. Properly applied where needed, this measure will bring safety and mobility benefits, and protect non-arterial streets from heavy through traffic.

5. *Traffic Signals*. Many traffic lights now used are obsolete, especially for serving heavy traffic. A comprehensive modernization program is needed. Lights should adjust to varying traffic needs at

different hours—favor the inbound morning traffic, equalize in the off-peak hours, and favor the outbound flow in the evening.

At major intersections where traffic needs change every few minutes, the traffic-actuated signal—which automatically favors the heaviest traffic volume—is proving a vast benefit.

Downtown, a special signal cycle is often needed for pedestrians. Signals with special buttons which pedestrians can operate are being used more frequently at school crossings and other special locations. Many traffic lights at minor intersections should switch to a steady "flashing amber" for the main route during off-peak hours, with "flashing red" for the minor route.

Specialized studies are the basis of proper traffic signal installation. Too often, lights are installed because of uninformed neighborhood pressures, and their time cycles are worked out without scientific study of traffic needs. Improperly applied traffic control devices often cause an increase in accidents and invariably result in greater confusion and delay.

6. *Channelization.* This is the use of pavement markings or raised islands to guide traffic into the proper lanes for orderly turns and through movement at intersections. Where such movements conflict seriously, channelization is even more important than traffic lights. It also frequently provides pedestrian "refuge" in the center of a wide intersection, for increased safety.

7. *Illumination.* Although only a third of traffic moves at night, two-thirds of all fatal accidents are at night, and the death rate per miles traveled is three times as great as during the day. Poor visibility, fatigue, and drinking are the prime causes.

There is a direct relation between good street lighting in cities and the night accident rate. For instance, Detroit found that when street lighting was reduced one-third, night accidents doubled in relation to day accidents. When half of the reduced lighting was restored, night safety improved 50 per cent. A lighting program for 30 miles of main Detroit streets cut night fatalities from 48 to 12 yearly on these streets, while the day fatalities remained unchanged.

In street and road lighting the equivalent of daylight illumination is not necessary. Rather, light should be cast on the roadway to permit "silhouette seeing" of pedestrians, parked vehicles and other obstacles. Experience indicates that rural lighting is needed primarily at major intersections and other hazardous locations, and that there must be more and better use of reflectorized signs and roadside reflector-delineators.

8. *Pedestrian Protection.* Three of every five urban traffic death victims are pedestrians. In rural areas, 40 per cent of those killed are

pedestrians. Such high percentages justify special efforts to lessen pedestrian hazards.

Jay-walking ordinances and tickets for violators are proving effective in many cities. There is increasing use of barriers to prevent pedestrians from mid-block crossings. Where pedestrian bridges or underpasses are built, they require such barriers to force their use.

Special traffic signals, lighted crossings, refuge islands in the center of wide streets, and special regulations at school crossings, all must be used more frequently in the future. In rural areas, many main roads need sidewalks.

The most urgent pedestrian safety need, however, is in the educational field. Various studies have indicated that *up to 95 per cent* of all pedestrians killed in traffic had never driven a motor vehicle and did not realize the hazards their actions were creating.

9. Street Widening. Although widening of streets to eliminate narrow sections, setback of curbs at intersections for better turning radius, and removal of streets jogs, all have a place in traffic improvements, it is recognized today that mere widening of a city street generally is wasteful and useless.

Widening a street in order to retain curb parking is definitely wasteful—the cost of off-street facilities is lower, and means greater safety. Angle parking on any main street is a particularly serious hazard and invariably creates a traffic bottleneck.

Widening and straightening of neighborhood streets is exactly contrary to the best interests of traffic and the neighborhood. Far better is the opposite step of dead-ending and narrowing many neighborhood streets, to discourage their use by through traffic.

10. Transit Operations. As a city grows larger, there must be increased use of mass-transit vehicles to meet transportation needs efficiently. Since these vehicles create extra traffic problems, special streets often are assigned to them, and special provision made for their loading operations on express highways. Skip-stops during rush hours, the provision of safe loading zones, and the staggering of working hours in industry and business places, all assist in relieving the traffic problems in rush hours.

TRAFFIC LAWS AND ADMINISTRATION

Because traffic operations involve complex problems and require special training and techniques for handling them effectively, experience has shown that the function is best carried out through a special traffic engineering division of the local government or state highway department.

For state highway agencies and large cities, all reputable studies

of recent years have unanimously recommended that this traffic engineering division be given authority equal to other principal divisions—and that road and street design engineers be trained in traffic operation principles. For smaller urban areas and county road departments, a position of comparable responsibility is recommended, headed by an official trained in traffic operations.

Since traffic operations are carried out through laws, control devices, and road designs, and traffic moves freely from city to city and state to state, basic uniformity in these controls is urgently needed. The application of the controls may vary with local conditions, but much needless confusion and countless accidents could be avoided if, for instance, all states agreed on the same type of rural pavement paint stripe to indicate "no passing" zones—and all cities used similar signs and traffic control signals to control similar problems.

Key elements of the traffic control program, then, are such nationally approved standards as the Manual on Uniform Traffic Control Devices, the Uniform Motor Vehicle Code, the Model Traffic Ordinance, and the various standards on road and street design and vehicle size and weight limits as adopted by the American Association of State Highway Officials.

Finally and importantly, no effective traffic operations program can be carried out in the local community without the active assistance of official and civic agencies in winning public understanding and support of the program.

Age-old traditions in use of roads and streets have of necessity been modified since the growth of motor traffic. In the future, still more modifications must be made, if problems of parking, accidents and delays are to be met.

Many traffic engineering remedies are vigorously opposed by the community at the outset. Frequently they must be put across by suggesting that they be given a fair trial and abandoned if they do not prove effective and popular. Invariably, *if they are needed and properly applied,* they prove both effective and popular. So intimately do most of us live with traffic problems that we quickly see the benefits of the change.

The program must begin by the establishment of a clear-cut responsibility for traffic operations in the official public agency, and the provision of a competent staff, trained in traffic operations, with an adequate budget.

This done, the rest follows. Accidents, congestion, parking problems, *can* be cut materially, and at little cost. Traffic engineering results throughout America are proof of that.

40 POLICE TRAFFIC CONTROL

BY FRANKLIN M. KREML

By all known standards, the degree of safety attained on the streets and highways of the nation and the mobility of traffic flow accomplished are conditioned by the processes of policing established. Adequate patrolling of the roadways and the strategic placement of point-control details are important elements in alleviating incidents of congestion and of assuring that engineering directives are obeyed by driver and pedestrian. The proper investigation of traffic accidents by enforcement officers is the crux of accident prevention, for it is axiomatic that the tragic consequences of accidents cannot be overcome until and unless the causes of accidents are identified and the required remedial measures taken. In the traffic police is vested the responsibility of accident investigation and of supplying other agencies with data essential to launching accident prevention measures.

In traffic safety education, the police occupy a position of great importance. The actions of traffic police officers constitute one of the most influential of all forces contributing to or detracting from the cause of safe and speedy transportation. Unprincipled or unqualified traffic police action aggravates unlawful conduct on the part of the public; exemplary traffic policing contributes immeasurably to democracy on the streets and highways. High in the listing of police responsibilities is alert observation of violations of traffic law, the apprehension of violators, and the marshalling of evidence for prosecution before courts of justice in order that the lives and property of the citizenry can be safeguarded from the hazardous actions of others. And, finally, among the prime responsibilities of the traffic police are the auxiliary services rendered to other agencies and functions: the supplying of accident and violation data to engineers, educators, and motor vehicle administrators; assisting in the registration of motor vehicles, the licensing of drivers, and the inspection of vehicles; and aiding the prosecution and the courts in the equitable adjudication of traffic violations. The cause of safe and speedy traffic movements is undoubtedly jeopardized if deprived of sound and adequate traffic policing.

The elements that enter into and the obstacles that impede effective traffic control by the police are manifold, and all must be given most searching consideration. To begin with, the quality of police

action and the direction such action can take is governed to a considerable extent by the competency of laws and ordinances. In every respect the traffic police officer is a law enforcement officer, and his actions are clearly directed and as rigidly restricted by law. To effectuate traffic safety the traffic law must be founded on at least two fundamental considerations: first, there must be uniformity of rules of the road and in the authorities granted respecting violations thereof; and second, legislation must be provided which will enable the police to make headway against driving and pedestrian action which imperils safe and expeditious traffic movement. In so far as quantity of legislation is concerned, the national situation might seem ideal, for such is the prolixity of legislation that if all laws and ordinances relating to traffic were put in book form they would probably fill 1,600,000 pages. But in quality, direction, and uniformity, the situation is far from satisfactory. Antiquated ordinances and statutes are still commonplace. Neglected in many areas is legislation providing for effective driver licensing, pedestrian action, vehicle inspection, and chemical testing for determination of alcoholic intoxication—to mention only a few. Much still remains to be accomplished in attaining the necessary degree of legislative uniformity in an era in which the boundary lines of city, county, and state are mere geographic symbols in so far as traffic flow is concerned. Where competent traffic policing is not attained, often an accusing finger can be pointed to legislative inadequacies. Such considerations as these some years ago led to the establishment of the National Conference on Street and Highway Safety and to the preparation of the *Uniform Vehicle Code* which has already exerted far-reaching influence in raising the level of traffic legislation.[1]

Second among the elements entering into the sufficiency or incapacity of traffic police action are those relating to organization and administration. It should be recalled that for countless generations the police in this country and abroad have been crime hunters

[1] The Uniform Vehicle Code was originally prepared in 1925-26 by the Conference in cooperation with the National Conference of Commissioners on Uniform State Laws. It was reviewed and revised by the National Conference in 1930, in 1934, in 1938, and again in 1944. In each case the revisions were based upon thorough study by a representative committee, extending over a period of months, of the provisions of the various acts in the light of experiences and changed conditions. The Code is comprised of five Acts: (1) Uniform Motor Vehicle Administration, Registration, Certificate of Title and Antitheft Act, (2) Uniform Motor Vehicle Operators' and Chauffeurs' License Act, (3) Uniform Motor Vehicle Civil Liability Act, (4) Uniform Motor Vehicle Safety Responsibility Act, and (5) Uniform Act Regulating to Traffic on Highways. In addition there was prepared a Model Municipal Code.

by habit as well as tradition. The coming of the automotive age for the time did little to shift this conception of police action, and only in recent years has there developed any real awareness of the fact that traffic policing must take its accredited place in the frame of police organization and administration. So long as traffic policing is treated as a subsidiary branch, or not given proper support, an impotent traffic program will result. Fortunately, the importance of a traffic division within the organizational framework of policing has been increasingly recognized in progressive departments. But, good traffic enforcement awaits the time when traffic units receive an "on par" status with those dealing with the enforcement of the non-traffic, criminal law.

One important hurdle blocking effective traffic law enforcement has been the lack of training of officers engaged in traffic control. While on the surface it may appear that traffic policing requires little in the way of instruction, such an assumption is wholly afield from the truth. Such is the complexity of traffic policing and so necessary is extensive and intensive training that the untrained police officer and the untrained police executive cannot perform capably. The need for training is evidenced in every phase of traffic policing, whether it be in the scientific investigation of accidents, in the selective assignment of personnel, in the recording of traffic data, in the marshalling of proof of violation, in the point-control of traffic, or in the organization of police action. And only within comparatively recent years has this need for training been realized and measures taken to meet it.

Development of a traffic training program in the Evanston, Illinois, Police Department marked the beginning of a movement which has now reached coast-to-coast proportions. The work in the Evanston Department led to the establishment in 1936 of the Northwestern University Traffic Institute, the only school devoted exclusively to the training of traffic police officers. In its first decade of service the Institute trained more than 1,100 police officers in the fundamentals of traffic control and accident prevention, and more than 304 carefully selected men in traffic police administration, the latter group coming from 39 states and several foreign countries.

But much yet remains to be done before the full advantages of training are brought to bear on traffic problems. Many police departments are focusing effort upon the in-service training of their own traffic personnel. But few have the teaching staff and other facilities required for comprehensive traffic training. Little as yet has been done in the way of pooling training resources on any regional or statewide basis. To some extent the colleges and universities are

turning interest to traffic training and some of them have offered facilities for short course instruction. But to the present time, training has been principally in the field of in-service programs. Good traffic law enforcement awaits the time when basic traffic instruction is begun in the schools. When the young men and women of today are given opportunity to study and learn the citizenship background to traffic control and the needs for such control, and when the mechanics and techniques of traffic control are taught in higher institutions of learning and in police schools, then and only then can the full advantages of training be realized.

Among the influences which nullify good traffic police action are those factors which inhibit traffic policing from reaching its proper status as a profession. The hand of partisan politics, as no other single force can, far too often cripples traffic enforcement. It reaches into the selection of manpower, the disciplinary action of personnel, the quantity and quality of equipment supplied, the levels of salary established, and the direction of police action taken. That important progress is being made in severing traffic policing from the grip of unwholesome partisan control is certain. That the road to complete separation is far ahead is equally true. Such a goal must be attained. Low salary levels, the uncertainty of the calling, difficult conditions of employment in many jurisdictions add to the problem of securing sound traffic enforcement. When well trained traffic officers can impartially enforce traffic laws in the true traditions of democracy, security on the streets and highways will be increased immeasurably.

A good police enforcement program cannot operate *in vacuo.* For traffic policing depends for its support and validation upon a variety of external factors. Traffic policing withers unless it has the firm backing of the executive and legislative branches of local and state government. Judges, prosecutors, and municipal attorneys must back police action by convicting and punishing those whose violation of law is proved. Antiquated systems under justices of the peace and weaknesses in prosecution have spelled the defeat of effective traffic policing in many instances.

The type and kind of roadway over which traffic must flow exerts an exceptional influence on driving and pedestrian action, and this in turn reacts on the measure of traffic policing required and the burden of enforcement. The quality and direction of community and statewide safety education programs are bound to influence driver and pedestrian habits, and these have an all-important bearing on the work of the traffic police. Moreover, the competency or incompetency of driver-licensing programs greatly affects traffic policing, for if the unqualified or lawless person is permitted use of the

highways the difficulties of traffic policing are aggravated proportionately. Over all is the pernicious influence of "the fix." It has long been a stain on the majesty of law enforcement, and has demoralized effective work by all agencies of enforcement and contributed to public apathy, even contempt, toward traffic control. Favoritism through "the fix" destroys public confidence and promotes practices of disobedience that are inimical to the proper administration of justice. Without public support the cause of good enforcement is doomed to failure.

Nor should it be forgotten that in the last analysis the problem of traffic control belongs to top officialdom. Broad programs of traffic safety, affecting the public welfare so deeply, are the direct responsibility of leading officials, whether in legislative halls, executive chambers, or in areas of business enterprise. Traffic control neglected on a high level has little chance of being carried forward on the lower police level. Policy and direction of traffic effort must issue from the top—from the chief executive of the nation to village leaders. That the quality and interest of topside leadership are factors of decisive importance in the conduct of traffic policing is obvious and beyond question.

Few have realized the exceptional influence which traffic law enforcement exerts on over-all law enforcement. Where violations of law occur the vast majority are violations of traffic law, not the criminal law *per se*. It is for this reason that the public respect for law is largely conditioned and influenced by the quality of work performed by the traffic police, the impartiality and equity of prosecution, and the democracy of judicial determination. It is in the traffic field, therefore, that justice or its converse is comprehensively at work and in a way that touches the life of, and can be understood by, the citizenry at large. That good traffic enforcement can do much to encourage general respect for our institutions of law and government is a certainty. That inefficiency and corruption in the traffic field can go far in destroying public confidence and in corrupting public morals is an accepted fact.

In the concept of peace preservation, traffic law enforcement holds a vital preventive role. It was neither designed nor intended to operate as a punitive weapon, but rather to teach and to prevent violation of law in accordance with modern sociological and criminological principles. As a matter of fact, the primary objective of traffic law enforcement is to gain *voluntary compliance* with traffic rules of conduct established by society for its best protection. Hence security on the highways can never be accomplished solely by resort to volume arrests. The way lies deep in the application of all *deterring*

means possible. The search for such deterrents and their impartial application is the root of sound traffic law enforcement.

The pages of history have seldom recorded such grievous losses of life as have occurred in the field of street and highway transportation. Since the turn of the century an estimated 851,000 persons have died in traffic accidents in the United States, a number more than twice the total of lives lost in our armed services during World Wars I and II.[2] Such a telling loss evidences why traffic accident prevention must rank in the forefront of traffic control procedures. Out of the necessity of combatting traffic accidents was born a principle of police action which has already contributed much toward reduction of accidents, and were it made effective on a nationwide basis would have an incalculable influence in lowering the accident rate. The principle, known as *selective enforcement* can be stated as follows: "It is the direction of police effort in terms of assignments and action taken by patrol officers in such manner that attention is given to areas, times and violations in proportion to their contribution to the accident experiences." In every respect it is a definitive and logical means of concentrating police effort at the time and place of accident occurrence and against those forms of violations which proportionately contribute to accidents. But despite the values and the needs of establishing the principle as the basis of traffic police action, progress so far has been only moderate. In the absence of nationwide adoption of selective enforcement lies one of the primary weaknesses in traffic law enforcement.

The principles of accident prevention and traffic control as exemplified by selective enforcement are no longer in the stage of theory. Many cities and states have applied them and have produced outstanding results. Cleveland, seriously alarmed by its accident rate, launched a vigorous prevention program and in 1938 reduced its accidents by 47.4 per cent. Providence in one year forced downward the number of traffic fatalities from 41 to 16. In 1938, Saginaw cut fatalities by 78 per cent. Oakland and Detroit enjoyed similar cutbacks in prewar years. And from 1943 to 1944 Milwaukee gained a 36 per cent reduction in fatalities, while the national average reduction for major cities was only 11 per cent. Evanston has for many years maintained a consistently low accident rate. In cold figures the impressive economic savings accruing from such reductions can be calculated. Not so easily measurable, but far more important, is the saving in human anguish. In the coming years the degree of

[2] Based upon Forrest E. Linder and Robert D. Grove, *Vital Statistic Rates in the United States*. U. S Department of Commerce, Bureau of the Census, (1943) pp. 210-20, 226-28, 235-236.

safety on the streets and highways will be determined by the extent to which the nation's police departments establish corrective principles and practices of selective enforcement.

The calling of The President's Highway Safety Conference in May 1946 marked an event of exceptional import in the establishment of nationwide effort to halt the alarming upswing in traffic accidents occurring since the conclusion of World War II. At that meeting, leaders in the field of traffic law enforcement, engineering, and motor vehicle administration pooled their ideas and expressed them in a series of blueprints which pioneer the way to accident prevention and corrective traffic control. One of the blueprints was the report of the Committee on Enforcement, prepared by the Traffic Division of the International Association of Chiefs of Police, the Northwestern University Traffic Institute, the National Safety Council, and various police, transportation, and casualty groups, and universities.[3] In that report a specific program was outlined, a plan of action projected based on sound principles and practices.

The report emphasized the need for specialization in traffic organization underlining the importance of skilled and trained traffic personnel and the proper administration of traffic functioning. Specifically, the report called for the establishment of sound policies since the public tends to observe the *enforced,* rather than the written, law. Eight fundamentals of policy were emphasized: (1) The basis of enforcement action must be reasonable and designed for prevention; (2) warnings are useful for minor offenses, but to be effective should be written warnings; (3) enforcement of vehicle defect repairs; (4) provide leniency for non-resident violators; (5) avoid special treatment of any class; (6) enforce pedestrian regulations and promote pedestrian education; (7) prosecute vigorously in both criminal and civil actions if violations result in accidents, and (8) apply the same vigilance to grade crossings as to dangerous intersections.

As may be anticipated, important attention was devoted in the report to selective enforcement. It stated: "Activity should be directed at those types of accidents most susceptible to prevention by enforcement; that is, those attributable to specific, known traffic violations which enforcement can reduce. . . . The basis for selective

[3] The following reports were issued by The President's Highway Safety Conference: (1) *Public Information,* (2) *Organized Public Support,* (3) *Education,* (4) *Engineering,* (5) *Laws and Ordinances,* (6) *Accident Records,* (7) *Motor Vehicle Administration,* (8) *Enforcement,* and (9) the composite report entitled *Action Program.* Copies of the reports are for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

enforcement lies in the valid assumption that the future accident experience may be predicated with reasonable accuracy by study of the past experience . . . insofar as conditions remain essentially the same. . . . It is necessary that the enforcement effort, and not just the plan, be truly selective. . . ." Exceptional attention was also devoted in the report to the tactics of traffic control and such recommendations as the following were made: (1) One-man traffic patrols usually are best because they insure maximum coverage; (2) local conditions determine whether automobiles or motorcycles are the most effective enforcement device; (3) in respect to vehicle conspicuousness, heavy patrol traffic supervision requires the use of more visibly marked cars; (4) patrol techniques should be divided between cruising and "non-obvious" supervision; parking at intersections, however, should be in the open; (5) special checks on a "limited basis" are desirable, but should be well organized and highly selective; (6) for speed checks, pursuit and pacing of a violator are usually satisfactory, if performed with safety and accuracy; (7) intoxication tests, established as valid by medical research and by legal rulings, are highly favored for they protect the innocent and expose those "under the influence."

Lastly the report of the Enforcement Committee pointed out that the arrest of violators does not constitute the real measure of enforcement effort. Rather it is the conviction not the arrest which is the true measure of enforcement quantity and quality. Case preparation and court work of police officers are therefore of vital importance and every effort must be made by the traffic police to cooperate with other agencies of enforcement that justice in its truest sense can be meted. Such, in briefest account, are some of the highlights of the *Report of Committee on Enforcement* of The President's Highway Safety Conference. It makes clear an integrated national program to bring safety and efficiency to the highways of the nation. It affirms the fact that only by vigorous application of soundest principles of traffic engineering, education, and enforcement can the critical issues of accidents, congestion, and other traffic inefficiencies be leavened. As application of these methods grows, the police can be expected to play an increasingly competent role in the attainment of safe and expeditious traffic—a goal so vital to the welfare of every community.

41 THE HIGHWAY AND THE PARKING PROBLEM

BY CHARLES S. LECRAW, JR.

AN ADEQUATE highway system—one affording completely free movement of vehicles—would still not solve our transportation problem. This is because the objective of every motor vehicle is a *terminal.*

The average motor vehicle, for instance, is in motion about 500 hours a year; it is *parked* the remaining 8,260 hours. During this year of travel, the average driver covers 9,000 miles. He covers them through a series of short trips, the average of which is 16 miles. Each short trip requires a place to park. Otherwise the purpose of the trip cannot be accomplished.

The parking problem plagues one principally in the congested areas of our cities, for city streets, constituting only 6 per cent of the total road and street mileage, serve approximately 30 per cent of the total traffic expressed in vehicle-miles. If parking facilities are not provided in downtown districts, all efforts to provide free movement for vehicles will be of no avail.

GROUPS AND INTERESTS AFFECTED BY PARKING

The parking problem is complicated by the fact that so large a number of individuals, agencies, and interests are directly concerned with it. The concern in some cases is limited to individual attitudes and whims. In others, large investments and business interests are at stake.

Merchants. In downtown districts, retail merchants are the group that parking most acutely affects. The very success of their business, many of them believe, depends importantly on parking space in front of their shops. Merchants protest any severe regulation or prohibition of curb parking. Such regulation, they say, would reduce the value of their business establishments. In practice, engineering studies and changes often prove these objections unwarranted.

Motorists. Motorists want the greatest possible convenience with maximum safety, minimum delay, and least possible expense—which means adequate space directly in front of the point where he wishes to do business. Such a situation is often impossible; and in the case of most businesses, only a small percentage of customers can be provided such convenience.

Property Owners. Owners of retail properties, particularly those in congested districts, believe the value of their real estate depends

to a large extent upon the accessibility of their property through curb parking. Like merchants and motorists, most owners resist attempts to prohibit curb parking. Few are willing to go to the expense of providing off-street facilities for employees and patrons.

Commercial Fleets. Ready access to roadways is necessary for the receipt and delivery of freight. This frequently requires special consideration for delivery trucks and other commercial vehicles.

Taxis. Loading areas at the curb are provided for taxis in the downtown districts of every city. These zones might otherwise be used by individual motorists. They therefore are part of the curb parking problem.

Mass Transportation. Buses also become a factor. Vehicles parked too close to street intersections or authorized stops prevent buses from pulling to the curb. When this happens they extend into other than the normal parking lane and block moving traffic.

If decreased traffic interference could make streetcar and bus service more comfortable, frequent, convenient, and rapid, more people would use mass transportation because it is cheaper than operating a private car. Increased mass transportation would reduce car usage and so relieve parking. How can this change in habit be brought about? Some cities have tried prohibiting curb parking in certain areas. In other cities, such as Philadelphia, Detroit, and Cleveland, the transit companies have been partly successful by providing parking space in outlying districts and charging a small fee which includes transportation into and out of the congested area.

ECONOMIC LOSSES FROM INSUFFICIENT PARKING FACILITIES

The unavailability of parking space in a business area creates an economic problem. When parking affects business directly, the economic influences are direct and can readily be measured and valued. In most cases, however, these influences are *indirect* and difficult to measure. Their effect is felt over long periods and in diverse ways. There is not available, therefore, much specific information on business loss from insufficient parking. Better ways should obviously be devised for measuring business and economic trends and relating them directly or indirectly to parking. This would provide more effectual data for general application and specific use.

A direct economic loss from a lack of parking facilities is measured in two ways:

Time Losses. A study conducted in Washington, D. C.,[1] showed

[1] C. A. Hogentogler, "Intangible Economics of Highway Transportation," *Proceedings, Highway Research Board,* XIII, 1934.

a time-loss of nearly 16 minutes for each 6-mile trip. That time was spent searching for a parking place and walking from the parking place to the ultimate destination.

Decrease in Tax Revenue. When a city's downtown district becomes inaccessible by motor vehicle, the motoring public soon transacts its business elsewhere. Many business establishments have therefore moved to suburban areas. A main reason their owners give is the need to provide customers with convenient parking.

Such decentralization of business can seriously affect a city's economic health. Central business districts pay a large portion of the property tax. In New Haven, Connecticut, for example, the central district pays 20 per cent of the city property tax on only 1½ per cent of the tax-paying area.[2]

It would seem, then, that any condition seriously affecting the taxes of a city must be regarded with grave concern by officials responsible for the city's welfare. Inadequate parking facilities, if not definitely improved, will seriously threaten all cities' economic future.

PARKING CHARACTERISTICS

Drivers of motor vehicles have many and varied interests and desires. Their reasons for parking are consequently varied. Numerous parking studies over a period of years, however, have determined certain "average" requirements which the motoring public has established.

Time Demands. Time demands for curb parking are fairly consistent in downtown areas. Studies indicate that about 80 per cent of the motorists desire to park an hour or less in these districts. (The figure varies from 60 to 90 per cent.) The modal value for curb parking time requirements is generally found to be about 30 minutes. Where *shoppers* have been segregated from other traffic parking at the curb, time demands are greater—often it may be three hours or more.

A recent survey conducted in Morristown, New Jersey, shows 40 minutes as the average time for downtown curb parking. Half of the cars parked 20 minutes or less; 75 per cent parked under 40 minutes; 12 per cent parked over the legal limit of one hour.[3]

Space Demands. Parking space demands vary with the time of day, day of the week, and season of the year. It is possible, however, to draw conclusions found generally true throughout various sections of the country.

[2] "Tomorrow Is Here," City Plan Commission (New Haven, 1944).

[3] National Conservation Bureau, *Traffic Survey—Report and Recommendations* (Morristown, N. J., 1946).

Parking spaces in central districts are in greatest demand between 2:00 p.m. and 3:00 p.m. on weekdays, Monday through Friday. Variance occurs with the size of cities. Cities of over 50,000 population usually have peaks between 11:00 a.m. and 3:00 p.m.; in cities under 50,000, the peak almost always occurs after 3:00 p.m. Travel distances and time are of course the influencing factors. A study in Detroit to determine the need for off-street facilities disclosed that when the peak of demand occurred, at 2:30 p.m. in this case, parking equalled 172 per cent of all legal spaces in the concentrated retail area.[4] Shoppers and others were parking in illegal spaces such as fire hydrant zones, loading zones, bus stops, and in other spaces that were restricted by law.

Walking Distances. Surveys have determined a definite limit drivers can be expected to walk from parking to destination. At the same time that cars were parked illegally in Detroit, legitimate spaces were empty in areas a few hundred feet from the concentrated retail area. Only 80 per cent of the curb spaces in an area surrounding the retail district were used, and only 37 per cent of the off-street spaces were occupied.

It is generally agreed that 1,000 feet is the longest distance an average person will park from his ultimate destination if he has to walk. This was verified in a recent study in Savannah, Georgia, where 89 per cent of all parkers interviewed parked at or less than 1,000 feet from their destination.[5] This distance varies, however, with the time a person desires to park. Table I is taken from a survey made in a Mid Western city. It shows that persons will generally walk farther than the average distance when parking for longer than the average time.[6]

TABLE I: CANVASS OF PEOPLE PARKED AT CURB AS TO DISTANCE THEY WERE WILLING TO WALK

	PERCENTAGES WILLING TO WALK, IN BLOCKS							
TIME PARKED	½	1	2	3	4	5	6	OVER 6
½ hour	2	41	36	14	4	2	1	0
1 hour	0.4	15	37	28	12	4	3	0.6
2 hours	1	6	28	29	23	6	5	2
Over 2 hours	0	2	20	33	20	13	8	4

[4] Koch, "Parking Facilities for the Detroit Central Business District," *1939 Proceedings, Institute of Traffic Engineers.*

[5] Hitchcock and Willier, "Determining Parking Requirements by Study of Parking Habits," *Highway Research Board,* XXIV, 1944.

[6] "Parking in Downtown Rockford, Illinois," Chicago Motor Club, January, 1942.

CONTROL OF CURB PARKING

To use streets for the dual purpose of moving traffic and storing vehicles, it is necessary to enforce regulations. Time regulations are imposed to allow the greatest use of curb space; and to protect *street* users and relieve congestion, curb areas are regulated.

General Parking Regulations. Parking regulations for curb control include basic rules by state codes as well as local rules by city ordinance. These regulations are enacted to provide *public safety* or *public convenience.* Proper education of the public as to the necessity for both making the regulations and complying with them is a major factor.

State Prohibitions.

(a) Uniform Motor Vehicle Code. It is essential that adequate and enforceable laws be enacted for the control of curb parking. Parking prohibitions are prescribed in the motor vehicle codes of all states. For uniformity and fairness, the basic provisions of Act V of the Uniform Motor Vehicle Code on the stopping, standing, and parking of vehicles are recommended.

(b) Model Traffic Ordinance. As with state codes, it is important that parking ordinances of municipalities be uniform and reasonable. The Model Traffic Ordinance, prepared by the National Conference on Street and Highway Safety is recommended.[7] In addition to recognizing the prohibitions and regulations of the Uniform Code, this ordinance regulates parking as to place, time, and other circumstances. In parallel parking, the wheels must be within 18 inches of the curb. Signs or markings must indicate angle parking space. Space must always be provided for moving traffic, even in alleys.

Time Limits. Parking regulations for public convenience include time-limits on curb use by individuals. Such regulations properly reserve curb spaces in most needed locations for short-time parkers. In establishing these limits, consideration must be given the type of business transacted in the area, enforcement strength, community parking characteristics, and the viewpoints of motorists and land users.

Parking Durations. As indicated under "Parking Characteristics" above, most motorists are ready to leave downtown districts after an hour, and the modal requirement is 30 minutes. Shoppers may stay two hours or longer, if allowed. Because of these characteristics, the usual parking durations are one hour or one-half hour in business districts, except at those places where short time parking only—usually 15 minutes or less—is allowed. In outlying districts, parking

[7] Articles XIII and XIV—*Model Traffic Ordinances* (Washington, 1946).

periods of two hours are common—aimed principally at preventing the use of the curb for long-time storage and to control all-night parking.

ENFORCEMENT OF CURB PARKING

In every city, the enforcement of curb parking regulations constitutes a large part of the responsibilities of the traffic enforcement agency. Large manpower and equipment requirements are necessary to enforce space and time regulations. Effective enforcement, however, pays big dividends in curb capacity and orderly traffic flow. It has been estimated, on the basis of a recent check in Morristown, New Jersey,[8] that curb parking capacity on all streets could be increased 14 per cent by enforcing the one-hour limit.

In most cities, the police are in the position of enforcing regulations that are contrary to public desire. Enforcement of curb parking regulations is not only one of the biggest jobs of city police, but one of the most unpopular.

Parking Meters. One of the newest means for controlling curb parking is the parking meter. It was not generally applied until the late 1930's, yet in a short space of time meters were widely accepted.

Parking meters cannot produce additional curb space. Some cities, in their endeavor to increase revenue, have made the mistake of installing meters near intersections and in prohibited zones. Such practices induce accidents and public resentment.

Meters do increase curb use for a greater number by increasing the turnover. Therein lies their chief benefit.

Legality of Meters Questioned. Because of many questions raised in cities in which meters were proposed or installed, court cases have arisen. In several instances, cases were carried to the higher courts. Except in very few cases, the courts have held parking meters legal as an aid to enforcement.

Cities Using Meters. By 1948, as shown in Table II, most of the installations of parking meters, on a percentage basis, had taken place in cities with populations over 10,000. Smaller cities had not installed many meters. Nearly four-fifths of the cities with populations between 25,000 and 500,000 had meters operating.[9]

Income from Meters. Meters have an excellent record as revenue producers in addition to their use as traffic control aids. In 1944, the 150,414 meters in 323 cities took in \$9,383,907—an average of \$62.38

[8] National Conservation Bureau, *Traffic Survey—Report and Recommendations* (Morristown, N. J., 1946).

[9] For earlier figures, see Municipal Finance Officers Association, *Parking Meters, Their Use for Traffic Control and Revenue* (March, 1946).

TABLE II: PARKING METERS BY SIZE OF MUNICIPALITY, 1948

POPULATION GROUP	TOTAL NUMBER OF MUNICIPALITIES IN U. S.	NUMBER OF METERED MUNICIPALITIES	PER CENT OF MUNICIPALITIES METERED
Over 500,000	14	9	64%
250,000 to 500,000	23	17	74
100,000 to 250,000	55	48	87
50,000 to 100,000	107	86	80
25,000 to 50,000	213	166	78
10,000 to 25,000	665	471	71
Under 10,000	15,675	1,125	7

Source: Vehicular Parking, Ltd., Canton, Ohio.

a meter. This average includes meters in operation only a part of the year, as well as meters in poor locations not economically successful. Considering valid meters only, income can be estimated at about $6 a month, or $75 a year. Table III illustrates actual meter revenue in seven cities in 1948.

TABLE III: PARKING METER REVENUES FOR SELECTED CITIES, 1948

CITY	POPULATION	NO. OF METERS	1948 GROSS REVENUE
Cleveland	878,336	2,559	$187,236
Buffalo	575,901	2,400	205,000
Minneapolis	492,370	2,175	330,304
Oklahoma City	204,424	980	79,132
Corpus Christi, Texas	57,301	686	65,381
Wilmington, N. C.	33,407	542	40,068
Brownsville, Texas	22,083	500	31,981

Source: Vehicular Parking, Ltd., Canton, Ohio.

OFF-STREET PARKING

While curb parking should receive its full measure of attention in a parking plan for any urban area, it is generally agreed that the curb alone cannot furnish parking space sufficient for the demand in urban areas.

To solve this problem, the question of adequate off-street parking space faces the majority of our urban areas. Off-street parking spaces now available vary from about 5 per cent to 30 per cent of the registered vehicles. The problem involves not only the provision of sufficient space, but of space efficiently located near areas of concentrated land use, and space attractively enough priced for the motoring public to use it.

There are three general modes of operation of off-street parking

facilities: (1) Private facilities, (2) privately operated public facilities, (3) municipal facilities.

Private Facilities. Such facilities usually are operated in connection with retail stores, hotels, or other business establishments. In some cases, the motorist pays directly for the service; in others, the cost may be absorbed by the business served, or driver and business may share the cost.

In St. Louis, a combined garage and bus service has been established for shoppers patronizing any of 130 stores and offices in the downtown section. Each time a purchase is made in a member store, 10 cents is deducted from the total parking fee. The fee is 10 cents for the first hour, 20 cents for two hours, 30 cents for three to five hours, and 35 cents for all day.

Another successful example of a private venture is the Oakland, California, experiment started in 1929, known as the Downtown Merchants Parking Association. This organization, now comprising 164 members, has acquired a number of strategically situated low-income properties for parking lots. Land is acquired by purchase or lease, with a ten-year minimum term for leased property and an average rental of 1½ cents a month for each square foot. The parking fee in the Oakland lots is 10 cents an hour; but the motorist can park free for two hours by having his parking check validated in a member store, whether a purchase is made or not. Because of the comparatively high hourly rate after the expiration of the free parking period, the rate of turnover is high as compared with the average commercially operated public parking facility. In one of the seven lots operated by the Oakland merchants, the daily turnover is as high as ten cars a space for each day.

Privately Operated Public Facility. The privately owned lot or garage provides the principal parking capacity in our downtown areas. This type of service has greatly increased in the last few years. In Los Angeles, off-street parking facilities increased from fifty in 1922 to 920 in 1938, with the capacity expanding from 4,000 to 65,000 cars. Chicago had sixty off-street facilities in 1927 and 237 in 1938.

Municipal Facilities. The third type of facility may involve parking as a municipal operation, with facilities furnished free to the motorist or at low rates made possible through sharing of the cost by property owners or taxpayers.

The use of municipally owned and operated facilities has been largely the result of failure on the part of private enterprise to provide sufficient parking areas properly located. Public action in this field has been established for more than twenty years. Flint, Michigan, established municipal parking in 1924. In 1926, Lafayette, In-

diana, authorized a bond issue of $52,000 to acquire lands for parking facilities.

In 1936, Garden City, Long Island, drew up a definite parking plan to serve its established business and apartment house section.[10] Land was obtained by condemnation, and the village now operates seven parking lots, with others to be installed as growth requires them. Parking is free: cost of construction and maintenance is paid by assessment against benefited properties.

Still another example of successful municipal operation of parking facilities is found in Kalamazoo, Michigan, where a large parking lot for shoppers is located in the central business district. A Shoppers Parking Lot Board of five merchants and property owners meets periodically with the Kalamazoo City Manager to set operational policies.

Methods of Finance. The cost of providing off-street parking facilities must be borne by one or more of the following: (1) The municipality. (2) The landowner or user. (3) The driver.

Many persons feel that terminal facilities are an integral part of any transportation system and therefore should be provided by the city. Still others contend that concentrated land use has brought about the parking problem and therefore the *land user* should provide parking for traffic generated by his business. A third group contend that driving a private vehicle into the downtown district is a luxury, and that motorists should logically be willing to pay for the parking aspects of it.

Ottumwa, Iowa, has provided a free parking lot for nearly 1,000 cars. All costs of construction were paid from profits from the water and power plants constructed at the same time as the lot. There is no charge to the motorist or to property owners or users.

Kalamazoo pays for its municipal parking, previously described, by assessing the cost against 120 benefited properties. Districts to be assessed were determined by the city assessor and twenty-five other citizens. The motorist pays part of the expense by being charged an hourly fee after a period of two hours free parking.

PARKING AUTHORITIES AND COMMISSIONS

Several cities have sought enabling legislation to create official public bodies to deal with the many complex problems of off-street parking facilities. Such authorities or commissions are usually given the right of condemnation and the right to levy assessments to subsidize parking developments. They may be required to operate facili-

[10] Allan H. Rogers, "A New Solution to the Parking Problem," *Public Works* (July, 1938), LXIX, No. 7.

ties directly or they may be authorized to lease publicly owned facilities to private agencies.

Such authorities should be non-political. They should provide a business medium through which all agencies interested in improving a city's parking conditions can work effectively together. They may be especially effective in bringing together the parking interests of *metropolitan areas* that consist of parts of several incorporated places.

The operation of toll bridges, tunnels, and toll roads in recent years has demonstrated the success of public authority administration. They have procured funds at low interest rates and operations have been maintained at high business levels to the benefit of the public. Such operations might be extended to parking facilities. In New York the Triborough Bridge and Tunnel Authority has started construction on a seven-story structure capable of handling well over 1,000 cars; located at the Battery, it will be the city's first publicly owned garage. In such projects, of course, there must always be proper governmental support, freedom from politics, and astute business management. Otherwise satisfactory and self-liquidating operations cannot be expected.

Authorities that require the endorsement of a majority, or fixed percentage, of the property owners in downtown areas before action can be taken to procure lands and levy assessments, may become involved in arguments and dissensions. And questions among property owners as to who will benefit most in relation to the location of facilities and subsidy assessments must be resolved.

42 THE SERVICE OF THE HIGHWAY

BY ORIN L. KIPP

THE inconveniences of even the most limited motor vehicle traveling during World War II served to accentuate the great part "services of the road"—filling stations, roadside restaurants, cabin camps, trailer camps, etc.—have in our normal, peacetime lives. Motoring, when the necessary gasoline or ration coupons were available, once again took on some of the difficulties which were experienced by the early motorists—yes, even some of the hardships and discomforts of the stage coach days were reenacted—all under the guise of "wartime shortages."

Man, it seems, is and always has been a nomad at heart. His urge to travel is found in his earliest records. But the difficulties inherent in any traveling served as a deterrent to any but the shortest, most essential trips. The dangers and discomforts of travel—bandits, inclement weather, lack of roads, and slowness of travel—were barriers which had to be surmounted before travel of any appreciable extent was to become feasible. The reduction of these obstacles is still going on and will continue as long as man retains his urge to travel.

The first inns were undoubtedly the dwellings along the way whose owners condescended to take in the weary traveler. There was no provision made for compensation for the few services, if any, which "mine host" often grudgingly provided. The traveler, before resuming his journey, however, would give his benefactor a small payment, usually in goods; and presumably it was this practice which led to the establishing of the first inns on a paying basis. The early inns were often mere "blinds," however, utilized by highwaymen and bandits to despoil the unwary. Inn-keeping gradually became a legitimate, profitable business—it is occasionally mentioned in Greek literature—but it was not until the recent stagecoach era that inns came into their own as homes for the bruised, hungry, and thirsty travelers. And as they became stopping-points for the lumbering stagecoaches, they attracted other enterprises having the welfare—and money—of the wayfarer as their concern. While inns provided lodgings, food, and drink, blacksmith shops serviced the horses and coaches, and shops of varying quality and integrity catered to the needs of travelers. The end result was the setting up of many of our present-day villages and cities, most of which have continued to progress, while others, because of various factors but chiefly because they were on

non-profitable routes, had difficulty in staying alive. They became the "ghost towns" and "rustic" hamlets of today which have been bypassed by the onrush of modern civilization.

With the coming of the railroads, long-distance highway travel disappeared, and with it the roadside inns and other services almost vanished—until the advent of the motorcar early in the twentieth century. And even while the more sanguine were sagely predicting that "the motorcar will never supplant the horse," others, more progressive, were beginning to realize the greater needs and potentialities of motor vehicle traffic. Obviously, the man who could afford a costly horseless carriage was a man of considerable means, and the canny innkeepers welcomed him under their roofs.

As the intrepid motorists grew in number and courage, they wandered farther and farther away from home. They made it a practice to travel along the roads where they were reasonably certain of obtaining gasoline and where a young and unorthodox blacksmith could be induced to make needed repairs. And as the motorists increased, the smithy's services became so much in demand that he forsook his anvil and devoted all his attention to the needs of the ever-growing motoring public.

But the service to the motorist's personal needs did not keep pace with even these still unsatisfactory caterings to his fallible horseless carriage. Meals at the roadside inns were unpredictable and uncertain; lodgings, when obtainable, were anything but satisfactory. These vagaries of travel, however, served to fit in with the then common concept of motoring—that it was a hazardous, reckless undertaking at best. Perhaps the indifference shown the wayfarer and his personal needs and comfort resulted from this popular notion.

With the automobile's gradual acceptance as a sensible and efficient mode of transportation, there came a myriad of inventions and improvements which took it out of the novelty and daredevil category and made it into a vehicle for use by the entire family. It was then that the various service installations of the road really became cognizant of the vast and unlimited potentialities which their field offered. With a sudden burst of enthusiasm and initiative, we witness the almost overnight springing-up of motor courts, drive-in roadside restaurants, one-stop service stations, carefully laid out trailer sites, and self-serve super-markets. This mushroom growth was interrupted by the restrictions imposed by our entry into World War II, but it has already shown vigorous signs of resurgence. What the future may bring is limited only by American ingenuity and resourcefulness.

One of the most common of roadside services is the familiar gas station. Its development from the curb pump in front of the village

general store to its present state is one of the more remarkable growths of an admittedly astonishing era. The limited facilities and accommodations of the old curb pump, where you were able to get only gasoline (when available) and bulk oil of uncertain origin, have been pushed into oblivion by the modern one-stop service station. Now a motorist can drive into a spacious gasoline station and before he has stopped his car one or more attendants, clad in natty uniforms, are beginning to "service" his car—wiping or washing the windshield, wiping the headlights, checking the water level in the radiator, checking the oil—all before inquiring as to your needs or wants of the moment. Upon request, they check the air pressure in the tires, add water to the battery, give you accurate road information and advise you on hotel and restaurant accommodations. And what does all this cost? Nothing more than the charges for gasoline, oil, or other supplies you purchase! The title "service stations" has rightly been given to these indispensable establishments of our modern road and highway systems. During the recent war, it is true, all did not live up to their names; but when it is considered that they had to contend with serious shortages, inexperienced transient help, and motorists intent on "babying" their cars, many of their sins of omission should be forgiven. Their postwar attitude is a definite indication that they wish to atone for their war-born lapses and are anxious to give as much service to motorists as their time, their personnel, and their facilities will permit.

Not only has the service station grown in the myriad services performed for the motorist; it has also grown in numbers. In the 10-year period from 1929 to 1939, the number of stations in the United States grew from 121,513 to 241,856, while total retail sales rose from $1,787,423,000 in 1929 to $2,822,481,000 in 1939, giving each station in 1929 an average income of approximately $14,700 and in 1939 of $11,670. From these figures it can be seen that although the number of stations increased during the 10-year period, and despite the fact that many of them took on a multiplicity of automotive and non-automotive items in true "drug-store" fashion, the average sales per station decreased. This drop was due, no doubt, to the great number of unprofitable or marginal stations operating on little-used secondary roads or to stations on much-traveled roads whose owners and/or operators failed to modernize their establishments and keep abreast of competition.

Although many hotels and restaurants in cities and villages along main highways made special efforts to cater to the early motor travelers, the first type of accommodation developed exclusively for such travelers was the "tourist camp." The earliest tourist camps were

simply places where motor travelers who carried their own equipment could set up their tents, cook their meals, and spend the night. At the start they were usually provided by the municipalities or by commercial organizations, without charge, to attract tourist trade to local stores, gas stations, etc. The free camps usually had only the most rudimentary facilities, perhaps a pump, a few picnic tables, and outdoor toilets. Later more elaborate camps were developed, a fee charged, and a variety of facilities provided, such as running water, masonry cooking grills, kitchens with gas or electric stoves, sheltered dining tables, modern rest rooms, and other conveniences not found earlier.

The facilities provided by the tourist camps enabled many car owners and their families to take trips which they could not otherwise have afforded. But the inconvenience of carrying tents, bedding, and cooking utensils in an already crowded car took away much of the pleasure of the trip, and this gypsy style of touring proved of only a few years duration.

With more and more motorists attempting to "get away from it all" while on their touring trips around the country, a demand arose for overnight cabins, and it was only natural that the first conveniences of this type were erected by enterprising gasoline station owners who saw in this venture a source of additional profits. The first tourist cabin camps catered to one-night rentals, with the occupants doing their own cooking or patronizing such restaurant facilities as the cabin court offered. These first cabins were little more than shelters, but as time went by cabins of sounder construction were built and the period rental increased to several days, but seldom did a touring party remain at a cabin for as long as a week.

Motorists who were interested not so much in covering many miles as in spending a comparatively comfortable vacation of several weeks duration found that the solution to their housing problem was the purchase of a house-trailer. Here they could spend from $500 upwards, and were able to go almost anywhere and still be certain of excellent touring facilities. Setting out from home on either a summer or winter vacation, they found any number of well laid-out trailer camps, usually situated some 30-40 miles outside all the larger cities. Here they could park their trailers, and at a cost of about a dollar a day, be furnished with electricity, water and sewer facilities, shower baths, and other amenities to make their stay as comfortable as possible. For entertainment, they could drive into the city, returning to their parked trailer for the evening. The trailer users often stayed at one site for as long as a week, keeping their driving with the trailer to a minimum while on their vacation. In 1936 there were some

15,000 trailer camps in operation, providing for the needs of approximately 150,000 trailer users. A current count of trailers in use would reveal a considerably greater number, and would show that a great majority of them are being used as year-round dwellings by many people unable to find homes of a more conventional nature. In fact, during the war, the government set up many trailer camp facilities for the use of both Army personnel and war workers because it was found that the trailer was entirely adequate for transient housing needs. The University of Minnesota, for example, purchased several hundred trailers to house returning veterans until more suitable housing facilities could be provided. When properly "winterized," the average commercially-built trailer can be as comfortable as a small apartment.

The multiplicity and often unrestricted growth of these roadside enterprises have been distinct factors affecting the safety of the roads upon which they have been located. Not only have busy intersections been seized upon for the locations of gas stations, but almost invariably these stations have tended to be of the less attractive variety, often placed as close to the roadway as possible in an effort to entice the greatest number of customers into their respective establishments. Peak business activities, invariably coupled with peak travel conditions, often result in congestion on station driveways, with the overflow sometimes impeding through traffic on the highways. With properly placed stations, however, these undesirable conditions do not normally develop. Popular roadside restaurants, too, sometimes present hazards to vehicular traffic, but probably the worst conditions result from beer and liquor establishments whose owners have not made proper provision for customers' parking. Encroachment on rights of way frequently forces patrons to park their cars along roadways, or inadequate parking facilities may force them to back their cars out onto the roadway into the traffic stream, frequently resulting in accidents. In Minnesota, for instance, there were 126 accidents in 1945 caused by vehicles entering traffic streams from roadside establishments. Obviously many of these accidents would have been prevented by more careful planning.

Another problem resulting from roadside, rural liquor and beer establishments is the ever-present drunk or careless driver. Accident figures for Saturday and Sunday evenings disclose a disproportionately high percentage of mishaps directly attributable to drivers who had spent most of the evening as patrons of one or more taverns. The relaxation of driving vigilance, which is too often a result of drinking, is undoubtedly a basic factor in virtually all these accidents. The curbing of this type of accident has been partially accomplished in

many states by the restriction of liquor sales to taverns situated in organized municipalities and by the restriction of hours of sale by beer parlors. Neither of these, however, has proved entirely successful, and accident-prevention authorities are still probing means of eliminating accident-producing situations resulting from the operation of roadside taverns.

One way of preventing the setting-up of accident-producing roadside establishments, especially at much-traveled intersections, is by purchasing sufficient right of way at these junctures to place these areas beyond the possibility of commercialization. These areas can then be properly seeded and landscaped to beautify them and yet prevent them from obstructing the vision of motorists. Further, the purchase of sufficiently wide right of way along all heavily-traveled roads will serve to remove business establishments far enough from the roadway to reduce the possibility of accidents caused by patrons entering or leaving the parking areas. Setting up of reduced speed zones in areas congested by numerous roadside business enterprises, where an abnormally high number of traffic accidents have occurred or are likely to occur, is often employed, but here the problem of enforcement enters into the picture. Most roadbuilders agree that it is preferable to build safety into the road by adequate planning and construction than to try to make the road safe by setting up hard-to-enforce rules and regulations. But in many places, of course, the cost would be excessive.

An increasingly popular addition to crowded highways is the roadside parking area, where the tired traveler can pull out of the stream of traffic and rest. Located at scenic spots along the road, they have proved very popular, not only with the average pleasure driver, but also with commercial drivers, especially of large trucks, who appreciate these opportunities for rest.

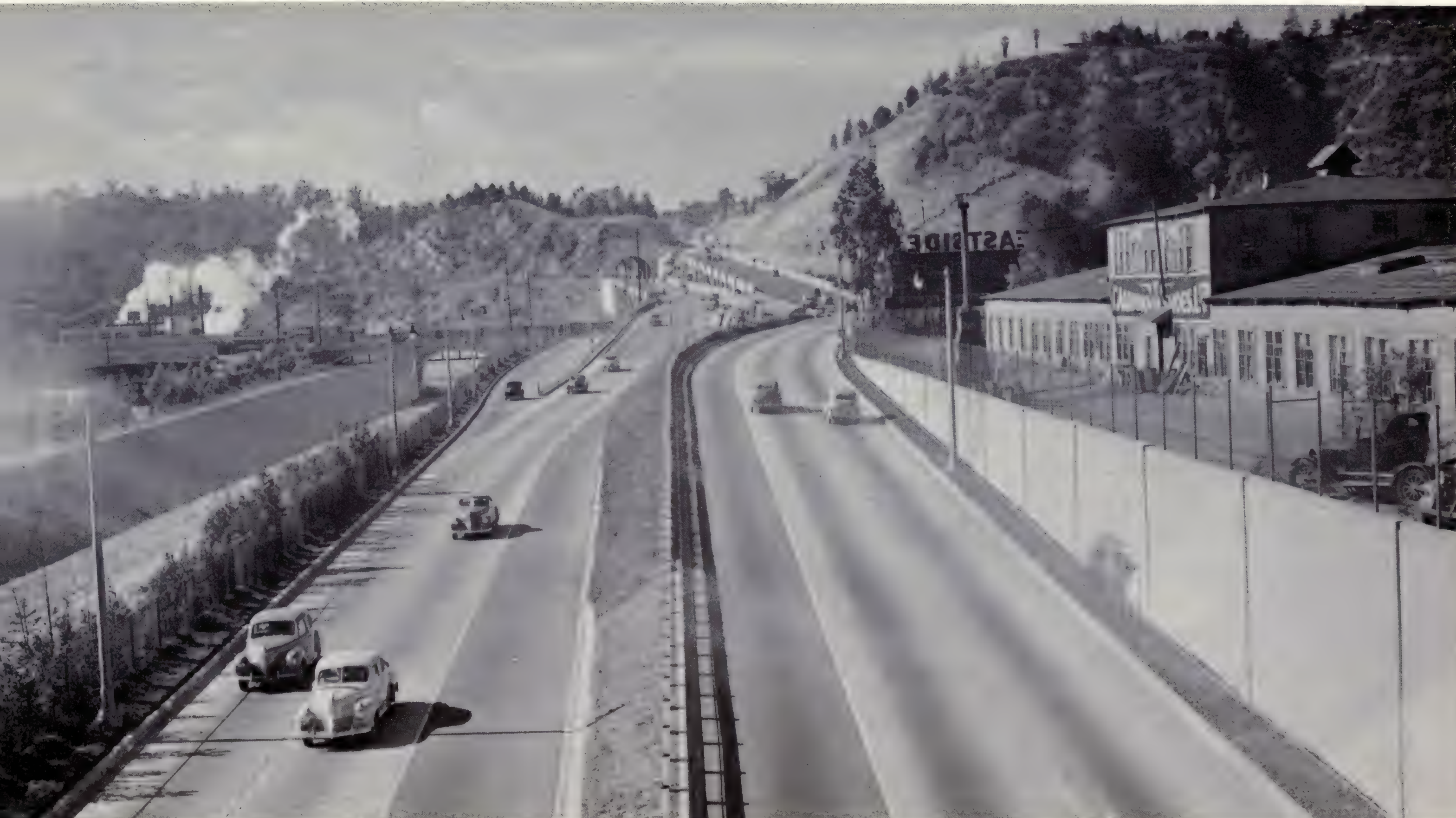
Carrying the roadside parking idea a little further, many states have set up picnic areas adjacent to their highways, affording travelers convenient and clean sites for picnics. The development of some of these, especially near metropolitan areas where they are most popular, has enabled the roadbuilder to make rather extensive improvements in the way of picnic tables, open fireplaces, rustic water wells, etc.—all of which are greatly appreciated and utilized by groups on small informal outings.

The roadside restaurant, gasoline service station, tourist cabin camp, and trailer court have become essential elements in our present-day highway travel. But if they are to fulfill their intended functions, without unduly creating hazards to normal highway traffic, it is necessary that definite standards of operation be agreed upon. This

can best be done by cooperating with the several associations with which each of these is invariably affiliated. In that way, uniform intelligent controls can be put into effect, whereby not only will normal highway traffic be safeguarded, but these essential roadside businesses will prosper and be better able to serve the traveling public.

NEW JERSEY HIGHWAY DEPARTMENT

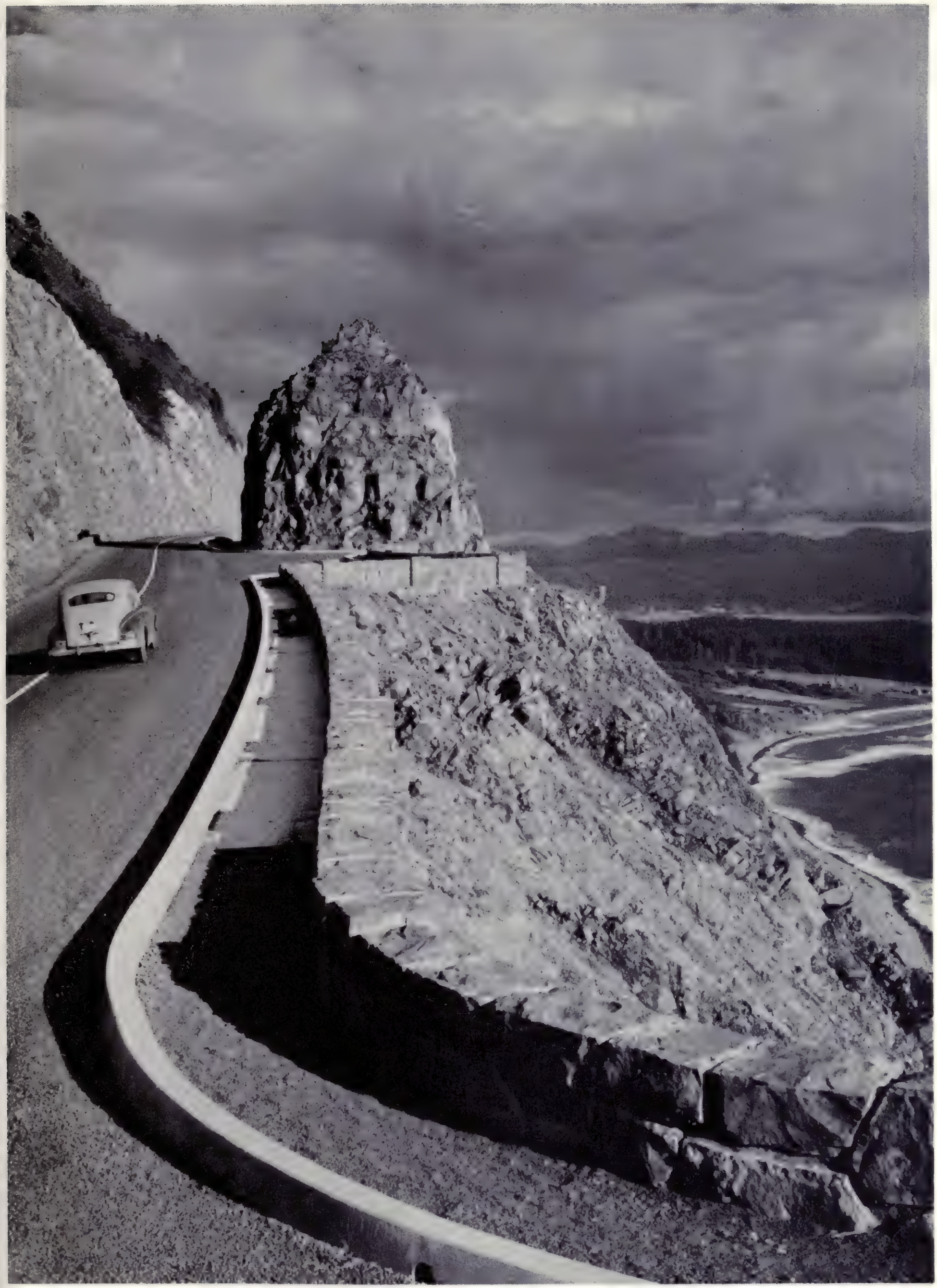
CLOVERLEAF AT WOODBRIDGE, NEW JERSEY
This has the distinction of being the first cloverleaf built in the country.



CALIFORNIA HIGHWAYS & PUBLIC WORKS

ARROYO SECO PARKWAY IN CALIFORNIA

This parkway serves traffic between Los Angeles and Pasadena. The view shows a sloped center strip and acceleration lanes.



OREGON COAST HIGHWAY
The rock pinnacle with observation point is a well-known landmark on the route. Note concrete half viaduct between protecting curb and wall.

BAKER GRAPHIC SERVICE

SOLUTION OF A DIFFICULT PROBLEM AT PALO ALTO

Notice the underpass of the Southern Pacific Railroad at the right and the overpass of U.S. 101 at the left.

GENERAL AIR VIEW OF THE SAME SCENE

43 MOTOR VEHICLE LEGISLATION

BY J. ALLEN DAVIS

AMONG the many thousands of legislative statutes enacted during the past thirty-six years a very substantial portion have pertained to the ownership, use, and misuse of motor vehicles. The ownership and operation of millions of motor vehicles, with a current registration of more than forty million in the United States, while conferring abundant benefits and advantages, has resulted, unfortunately, in the loss of many thousands of lives per year, a larger number of persons injured, and, in the aggregate, tremendous property loss due to traffic collisions on our streets and highways.

In an effort to cope with traffic accident problems our state and local governments have been diligent in the enactment of laws and ordinances providing for the registration and identification of motor vehicles, the licensing of drivers, and imposing restrictions and regulations applicable to the movement of vehicles, pedestrians, and public conveyances. These statutes are designed to control, safeguard, and facilitate all forms of traffic movement on public highways.

Many such laws and ordinances have been enacted upon a trial-and-error basis, necessitating periodic reconsideration and revision. Also, additional laws and ordinances, or amendments and revisions, have been necessary in order to keep pace with changes and improvements in motor vehicles and in the design and construction of highways. This process of evolution in traffic laws and ordinances has indicated numerous sound basic principles which should be retained, although various detailed rules and procedures will need further revision.

Thus, the traffic laws as originally enacted have not remained static, and in some states and municipalities greater progress has been made than in others in modernizing the laws and prescribing the respective rights and duties of all users of the highways.

It is a fact that the legal problems in respect to ownership and operation of motor vehicles have occasioned the most prolific source of litigation the world has ever known. Countless decisions have been rendered determining the rights of injured persons to recover damages. Many courts have been overburdened with both civil and criminal cases involving the determination of civil liability and the guilt or innocence of persons charged with traffic offenses.

Fortunately, upon the advent of motor vehicles the courts were

not without legal principles and precedents to guide them in determining the right of one motorist to recover damages from another. The basic principles of negligence under the common law had been developed during the past centuries, and the courts applied and continue to apply such principles in traffic accident cases.

Motor vehicle legislation declaring rules of the road has made more specific the requirements as to the exercise of due care in the operation of motor vehicles. It is a basic principle that violation of any of the regulations as to traffic movement shall be deemed to constitute negligence as a matter of law. Evidence is then required as to whether such failure to comply with the statutory requirements was the proximate cause of the collision resulting in damage.

Thus, in determining traffic collision cases our courts are called upon to apply both statutory motor vehicle laws and the basic principles of the law of negligence derived from the common law as defined in past decisions.

FEDERAL MOTOR VEHICLE LEGISLATION

The Congress of the United States has enacted a few statutes applicable to motor vehicles under the constitutional grant of power to regulate interstate and foreign commerce. In 1935 Congress enacted the Motor Carrier Act, applicable to the transportation of passengers or property by motor carriers engaged in interstate or foreign commerce. Administrative authority is vested in the Interstate Commerce Commission and its Bureau of Motor Carriers, which has promulgated numerous rules and regulations applicable to the safety and efficiency of interstate transportation of persons and property by motor carriers.

Another Federal statute, known as the Dyer Act, pertains to the transportation of stolen vehicles from one state into another and imposes severe penalties. Federal narcotic laws include penalties for illegal transportation of narcotics in motor vehicles. The former Volstead law authorized the confiscation of motor vehicles for illegal transportation of intoxicating beverages.

It may be noted that Congress also enacts the traffic laws applicable in the District of Columbia. However, the most extensive motor vehicle legislation is found in the statutes of the several states and the ordinances enacted by municipal and county legislative bodies. By reason of the constitutional separation of powers as between the Federal and state governments, and for practical reasons, it is recognized that state laws rather than Federal enactments should be the basis for motor vehicle legislation. Motor vehicle laws, to be effective, must be enforced, and the Federal government is not equipped

with administrative, enforcement, or judicial agencies appropriate to control traffic in all parts of the United States.

STATE MOTOR VEHICLE LAWS AND TRAFFIC CODES

Each of the forty-eight states, acting under its constitutional authority, known as the police power, to adopt measures for the public health, safety, and welfare, has enacted statutes pertaining to the ownership, operation, and use of all types of motor-propelled or motor-drawn vehicles.

In some states the majority of such laws are included in a code of motor vehicle laws. In other states separate statutes have been enacted from time to time dealing with special subjects pertaining to the ownership or operation of motor vehicles. Generally, such separate statutes relating to motor vehicles are compiled and issued in pamphlet form by the department charged with the registration of motor vehicles.

In order to comprehend the scope and nature of state vehicle codes and traffic laws, it is desirable to consider the same under certain headings, such as the administrative authority vested in state departments, the registration of motor vehicles, and others, in the appropriate and usual sequence.

State Administration of Motor Vehicle Laws. Legislative statutes in every state designate a state officer charged with the administration of motor vehicle laws. In a substantial number of states, a separate department of motor vehicles has been created, with a director or commissioner directly responsible to the Governor. In some instances such motor vehicle departments are divided into bureaus charged respectively with the responsibility of registering motor vehicles, the licensing of operators and chauffeurs, and in some states the enforcement of the traffic laws by a state highway patrol.

In other states the office of motor vehicle commissioner is an agency of the department of revenue, the highway department, or the secretary of state. There is no uniformity as to organization of the motor vehicle departments or bureaus in the forty-eight states, and likewise none as to their powers and duties.

Registration and Certificate of Title Laws. Every state requires the registration of all motor vehicles, trailers, and semi-trailers operated on public highways, with certain exceptions. Special provisions apply to the operation of vehicles by motorcar manufacturers, dealers, and persons transporting motor vehicles for purposes of demonstration, sale, or delivery.

Every state grants to non-residents operating private passenger vehicles properly registered in the home state of the owner the privi-

lege of operating without payment of fees for specified periods which vary in the several states. Approximately twenty-eight states grant reciprocal privileges to non-residents.

Generally, the state laws grant very limited or no privileges to commercial vehicles from other states. The prevailing requirement that commercial vehicles shall be registered and subject to fees and taxes in each state in which operated results in substantial interference with commercial transportation by motor vehicles across state lines.

Every state department upon registering a motor vehicle is required to issue a registration card and at least one, and in most instances two, license plates to be displayed on the vehicle. There are two major purposes to be served by required registration of such vehicles.

First, it is desirable that means shall be available for the identification of vehicles and the ownership thereof in the event of theft or if involved in accident or traffic violation. Thus, state departments generally maintain separate records of registered vehicles: (1) under the registration or license number assigned to the vehicle; (2) alphabetically under the name of the owner; and (3) under the motor or identification number of the vehicle. Each such index serves as a means of ascertaining the complete registration information concerning a vehicle upon knowing either the name of the owner, the license number, or the motor or identification number.

Second, the registration of motor vehicles, including the issuance of license plates, is a means of insuring and providing evidence of the payment of registration and other fees and taxes annually which are, in most states, used in part to defray the cost of state administration of the motor vehicle laws and in part for the maintenance and construction of highways.

In thirty-three states the law requires the issuance by the state department of a certificate of title in addition to the registration card. While state laws require that a registration card shall be carried in the vehicle or upon the person of the driver, there is no such requirement in reference to the certificate of title. In fact, it should be kept safely apart from the vehicle, as it affords the means of transferring title or right to possession of the vehicle by endorsement of the signatures of the transferor and transferee on the certificate.

Certificates of title also show liens or encumbrances on the vehicle as reported by the owner, while some states provide that liens are not valid unless shown on the certificate. A certificate is not a guarantee by the state of the title or ownership of a vehicle, and the effectiveness of a certificate in giving assurance as to the ownership of and liens

upon a vehicle depends upon appropriate administrative procedures. These procedures are not uniform in the forty-eight states.

Operators' and Chauffeurs' License Laws. It is a major function of government to afford protection to all persons within its jurisdiction. Thus, the government in the exercise of the police power may impose restraints upon individual actions which jeopardize the lives and property of others. The operation of motor vehicles by incompetent, reckless or antisocial persons results in extreme hazard, loss of life and damage to the property of other users of public ways. Our courts, therefore, have consistently declared that the operation of a motor vehicle is a privilege which may be granted upon condition and is not a right to be exercised without restraint.

The laws in all states except South Dakota provide that no person shall drive a motor vehicle upon a highway unless licensed as an operator or chauffeur by a designated state agency, except certain persons in military service, certain non-residents licensed or permitted to operate in their home state, and persons operating specified types of equipment such as farm tractors which are seldom and only incidentally operated on public highways.

In forty-four states and the District of Columbia the laws provide for the examination of applicants for drivers' licenses, which include in most instances a test of the applicant's vision, his knowledge of the traffic laws, and a driving test to determine his ability to drive safely.

The state departments are prohibited from issuing licenses to unfit persons or to persons under certain age limits, which range from 14 to 18, although the minimum age of 16 is the one most frequently specified.

A large number of states impose special conditions upon the licensing of minors, requiring the parents or guardian to sign the application, with resulting statutory liability within certain maximum amounts for any damages caused by the negligent operation of a motor vehicle by such minor.

Traffic courts are generally authorized to suspend or revoke licenses upon conviction of a licensee of a traffic violation of a serious nature involving hazard to others, or death, injury, or property damage. Also, motor vehicle commissioners in most states are authorized to suspend or revoke licenses for causes which in some instances are specified in the statute; while in others, broad discretionary authority is vested in the commissioner.

The effectiveness of drivers' license laws depends not only upon the scope and severity of the statutory requirements, but even more upon the administrative procedures employed by the state authorities. Those most conversant with drivers' license laws and their

administration recognize that by reason of inadequate standards and general leniency they have not fulfilled all the purposes intended.

The public has supported government officials in drastic administration of certain types of licensing laws, as for example, the licensing of aircraft pilots; but our citizens, generally, have maintained the attitude each for himself that operation of a motor vehicle is essential in business and social life. Thus, public officials have hesitated to exercise fully the powers vested in them.

Furthermore, the magnitude of the task of examining millions of applicants and the burden of conducting hundreds of thousands of investigations to determine the appropriateness of orders for suspension and revocation has presented serious administrative and financial problems.

Unfortunately, some states which have imposed substantial taxes on motorists, including special drivers' license fees, have failed to use such revenues exclusively for the enforcement of traffic laws and the improvement of highways, but have appropriated substantial portions for other governmental purposes. A number of state constitutions have been amended to prohibit such diversion of motor vehicle revenues.

Financial Responsibility and Security Laws. With the increasing use of motor vehicles in the decade 1920-1930, and consequent increase in traffic collisions, it developed that many innocent victims were unable to obtain payment for damages because those motorists legally liable were without financial resources, or by devious means avoided payment.

During past years, many agencies, both official and unofficial, have sought appropriate remedies to meet the problem of uncompensated traffic accident claims. In 1927 Massachusetts adopted a compulsory automobile insurance law. Upon first impression, compulsory insurance would appear to be an easy and obvious solution, but many objections have developed and no other state has enacted this type of law.

A total of forty-one other states and most of the provinces in the Dominion of Canada have enacted safety responsibility laws and have revised and strengthened them from time to time. Although there is some variance in the requirements of the safety responsibility laws, practically all include the following provisions:

The commissioner of motor vehicles shall require any person whose license has been suspended upon conviction of a traffic offense to furnish proof of financial responsibility before the license may be restored. Further, the commissioner is required to suspend the operator's or chauffeur's license of, and the registration of any motor

vehicle owned by, any person who fails to pay a traffic accident judgment within a specified time after the same becomes final.

Such suspension shall remain in effect until the judgment debtor has paid the judgment up to certain specified amounts, and has filed proof of financial responsibility for the future. Such proof may be given either by obtaining a motor vehicle liability policy, or policies, or by furnishing a bond, or by deposit of money or securities in the amount of $11,000 with the commissioner.

The commissioner is authorized to release such proof after a stated number of years, usually three, provided no action on a traffic accident claim is pending and no traffic accident judgment remains outstanding, and the person involved has not been convicted within the period of any offense requiring suspension or revocation of license.

All those states enacting the foregoing provisions have retained them. Experience has demonstrated, however, that they are not fully effective in compelling the payment of valid traffic accident claims. Thus, additional security requirements have been enacted, first by New Hampshire, then New York, and in more recent years by eighteen additional states. Such financial responsibility laws, with added security requirements, are generally deemed most appropriate and effective in eliminating from the highways the financially irresponsible and insuring the payment of valid traffic accident claims.

The additional security provisions apply in respect to traffic accidents in which any person is killed or injured, or in which damage to the property of any one person exceeds a stated amount, usually $25 or $50. Every motorist involved in any such accident must report the facts to the department of motor vehicles. The commissioner shall suspend within sixty days the license of each operator and all registrations of each owner of a motor vehicle involved in the accident, unless such operator or owner, or both, shall deposit security in a sum sufficient in the opinion of the commissioner to satisfy any judgment or judgments for damage resulting from such accident.

The deposit of security is not required of an operator or owner who at the time of the accident had in effect an automobile liability policy with respect to the motor vehicle involved. There are other exceptions to the requirement for deposit of security, for example, in the event there was no injury or damage to the person or property of anyone other than such operator or owner. Exemption also applies to the owner or operator of a legally parked vehicle and to an owner whose vehicle is operated without his permission, express or implied.

The security deposit laws authorize recourse to such deposits to

pay any judgment against the person who made the deposit. The commissioner is directed to return any such deposit after a stated period if no judgment is obtained, or claims arising out of the accident are settled and releases obtained by the parties involved.

It may be anticipated that additional states will revise their laws to include the basic features of the safety responsibility and security laws as outlined above.

Traffic Laws—Major Offenses and Rules of the Road. In every state laws have been enacted prescribing severe penalties for certain offenses, such as failure to stop in the event of an accident, for manslaughter or negligent homicide resulting from the operation of a motor vehicle and for driving while under the influence of intoxicating liquor or drugs affecting the ability of a person to operate a motor vehicle.

In a few states reference is made to chemical tests to determine the effect of intoxicating liquor, and presumptions are declared based upon the percentage of alcohol in the blood of the person examined.

The motor vehicle laws in at least forty states define the crime of reckless driving and declare substantial penalties. However, there is considerable variance in such definitions. The majority of these states so define reckless driving as to mean a willful disregard for the safety of persons or property, something more than simple negligence; while six states define the offense in general terms and then particularize by setting forth a more or less complete category of bad driving practices which shall constitute reckless driving, or by enumerating certain rules of the road, non-observance of which is declared to constitute reckless driving. Such enumerations include offenses which do not in all instances involve actual hazard, and in this respect do violence to the usual concept of reckless driving.

Speed Regulations. A review of the state traffic laws governing speed discloses that there are three distinct types of speed laws in the United States.

The laws in fourteen states do not declare any speed limits in miles per hour in rural areas, but rely entirely upon statement of a basic rule that speed shall be reasonable and prudent under the conditions.

Certain other states, fifteen in number, specify absolute maximum speeds in rural areas which range from 40 miles per hour in one state to 60 miles per hour in four states.

The remaining states have adopted prima facie limits, usually 50, 55, or 60 miles per hour; although a few enacted special wartime limits of 30 or 35 miles per hour, some but not all of which have since been revised. The statutes define the prima facie law to mean

that a speed not in excess of the prima facie limits shall be presumed to be reasonable and prudent, and therefore lawful; and that any speed in excess of the prima facie limits shall be presumed to be unreasonable, unsafe, and therefore unlawful. However, in either event the presumption may be overcome by evidence that the actual speed of the vehicle was or was not excessive, having regard to all the conditions then existing.

In every state, either by state laws or by local ordinances, more restrictive speeds are imposed in business and residence districts, and under specified conditions or in special zones.

It is obvious that motorists, particularly those driving interstate, are confused by such diversity in type of speed regulations, and in the miles per hour declared in the laws, and there is urgent need for greater uniformity in the laws governing speed in the United States.

The state traffic laws include a multiplicity of rules of the road prescribing the right of way at intersections and elsewhere, proper methods of making turns and the signals to be given, required stops at the entrances to through highways and elsewhere, proper procedure in overtaking and passing other vehicles and street cars, and the respective rights and duties of motorists and pedestrians. The violation of any such regulation is a criminal offense and punishable as a misdemeanor.

During recent years a substantial number of states have enacted modern traffic rules, conforming with the Uniform Act Regulating Traffic on Highways, a part of the recommended Uniform Vehicle Code to which further reference will be made in this essay.

The motor vehicle laws in every state include numerous regulations relative to the equipment of vehicles. Many of such laws particularize as to the standards to be met by lamps, brakes, horns, mufflers, windshield wipers, and other items of equipment.

Also, the state laws impose restrictions on the size, weight, and loading of vehicles, some of which are so restrictive as to interfere with the freedom of interstate movement of commercial type vehicles.

Legislatures have been diligent in levying fees and taxes of various types and amounts on motor vehicles in addition to motor fuel taxes in effect in every state.

In many state laws special procedures are prescribed in effecting the arrest of, and requiring the appearance of, those charged with traffic offenses. All vehicle codes and traffic laws include penalties for violations by way of fines or imprisonment, or both, frequently graduated according to the seriousness of the offenses committed.

Municipal Traffic Ordinances. The authority of cities, towns, and

villages to adopt traffic regulations by ordinance is determined by the constitution in the several states. A number of constitutions prohibit municipalities from invading the field of traffic regulations enacted by the state legislature. Thus, in these states municipalities are limited as to the scope of their traffic ordinances to local parking and other regulations not covered by state law.

In certain other states municipal traffic ordinances, as legally permissible, frequently include substantially all of the rules of the road, such as speed regulations, right of way, and other rules as usually found in state vehicle codes and traffic laws.

PROGRESS IN UNIFORM TRAFFIC LAWS

With continuing increase in interstate motor traffic, the necessity for uniformity in traffic laws, particularly those regulations applicable to the movement of vehicles, has received the attention of governmental agencies, civic organizations, and the motoring public.

In the decade 1920-1930 a National Conference on Street and Highway Safety was organized under the auspices of the Department of Commerce of the United States and supported by practically all national and many state and local organizations concerned with highways and traffic safety.

This Conference, through an appropriate committee, developed a proposed Uniform Vehicle Code, covering practically all phases of state motor vehicle legislation. Also, a Model Traffic Ordinance was prepared and recommended for future local enactment by municipalities.

At the President's Highway Safety Conference, which met in Washington, D. C., May 8, 9, and 10, 1946, a report was made by the Conference Committee on Laws and Ordinances regarding the demand and necessity for uniform traffic laws and the extent to which the states have adopted the Uniform Vehicle Code, or revised their laws to conform therewith; also, as to the progress attained in uniform traffic ordinances.

The report revealed that during the past twenty years commendable progress has been made in the modernizing of state traffic laws based on or in conformance with the Uniform Vehicle Code; also, that the Model Traffic Ordinance has been very widely adopted by municipalities throughout the United States.

The President's Highway Safety Conference adopted an action program, which, in reference to laws and ordinances, declared as follows:

"The Conference emphasizes the importance of uniformity in State and local traffic laws and regulations, and recommends adop-

tion by all States and municipalities of the standards set forth in the Uniform Vehicle Code and the Model Traffic Ordinance.

"Specific recommendations to these ends are as follows:

"1. That States recognize the need for uniformity in text for the rules applicable to traffic movements, and for uniformity in substance as to all other provisions of the Uniform Vehicle Code; and that the laws of each State follow the Uniform Vehicle Code arrangement and sequence.

"2. That each State legislature authorize a regular or interim committee to determine, with the assistance of an appropriate advisory group including representatives of official and unofficial agencies, the extent to which motor vehicle laws comply with the Uniform Vehicle Code, and to recommend necessary revisions.

"3. That the responsible State officials currently advise their governors and legislatures as to the conformity of legislative proposals with or departure from the Uniform Vehicle Code, and that proposals which depart essentially therefrom be disapproved.

"4. That each State publish a summary of its vehicle laws and publish separately in lay language, with illustrations, the substance of its rules of the road.

"5. That governors of neighboring States join in calling regional conferences of legislators and public officials to further the uniformity of traffic laws.

"6. That municipal ordinances and administrative regulations respecting motor vehicles and their use be similarly reviewed and revised to bring them into conformity with the Model Traffic Ordinance and with essential provisions of the Uniform Vehicle Code, and that laymen's summaries of such ordinances be published.

"7. That uniformity in the administration, interpretation, and enforcement of uniform traffic laws and ordinances is of the utmost importance.

"8. That uniformity in traffic signs, signals and markings in conformity with the Manual on Uniform Traffic Control Devices be attained by cooperative action of local, State, and Federal street and highway authorities.

"9. That aggressive action to further the enactment of the Uniform Vehicle Code and Model Traffic Ordinance by the States and municipalities is an important function of the national, State and local coordinating bodies as described in the Plan of Action recommended by this Conference.

"10. That provision be made for periodic review of these standards by the National Committee on Uniform Traffic Laws and Ordinances."

44 MOTOR VEHICLE ADMINISTRATION

BY BASIL R. CREIGHTON

WHEN motor vehicles first appeared on our streets and highways at the turn of the century, individuals and government quickly recognized the need of identifying a vehicle with its owner as a protection against theft. Accordingly, local authorities undertook to provide this service on a voluntary basis. Registration of vehicles was often accomplished by a motorist selecting his own numbers and advising a local official that such numbers had been affixed to the vehicle—usually on a leather tag. The local official filed the record by name and by number. Duplication of numbers was avoided by a simple checking procedure to ascertain if another person had previously selected similar numbers.

This method of registering vehicles was short-lived. As the number of vehicles increased, local authorities secured the passage of ordinances establishing a more orderly procedure of registration. Some of these early enactments also granted regulatory powers. Thus, the basic pattern of motor vehicle administration was established and has continued its growth to the present time.

As registrations mounted and motor travel increased, the demand for the extension and new construction of roads resulted in taxation. Fees were levied at the same time the vehicle was registered. Early "good roads" movements, frequently financed by direct contributions from civic organizations, lost favor with the public as the feeling grew that those who used the roads should pay for them. Organizational interest in providing facilities for vehicular traffic as a stimulant to local enterprise was thus superseded when responsibility was transferred directly to the community. This was accomplished through the inclusion of a fee for registration as a tax to provide highway construction funds.

The addition of the taxation feature to the already established registration procedure required little more than passing laws or ordinances establishing a rate structure for the payment of certain fees.

The imposition of taxes on a local basis, however, was also of short duration. The extension of roads beyond city boundaries made intercity travel a possibility and resulted in the entry of the states into the field of vehicle registration and taxation. In the evolution of registration, cities and counties grudgingly relinquished their rev-

enue collection functions to the state. Percentage refund arrangements, however, were substituted to provide funds for local needs.

In 1901, New York passed the first motor vehicle registration fee law, in recognition of the need of a uniform registration practice. This law did not classify motor vehicles in any particular way, but imposed a uniform fee for all registration. In 1903, Massachusetts and Connecticut likewise enacted legislation requiring the registration of automobiles and motor cycles on a statewide plan. Many of the early systems were conducted on a basis whereby a flat fee once paid effected registration for the life of the vehicle.

Collection of revenue together with identification of vehicles became, at first, the most important functions of motor vehicle administration. This was due primarily to the size of the job to be performed. However, as modern methods were adopted and registration procedures improved, the collection of revenue declined in importance to its proper place in the registration picture.

Meanwhile, motor vehicle regulatory functions, which at first were of minor consequence, grew significantly as the administrator's interest in traffic safety developed. A result of the expanding interest in accident prevention and a development of leadership in the traffic safety field, this phase of motor vehicle administration has assumed a role of tremendous importance.

As a consequence, the motor vehicle department of today is the agency of state government concerned with the regulation of motor vehicle operators and motor vehicle usage. Indeed, state legislatures have seen fit to vest in the departments not only the responsibility but the authority for a multiplicity of other functions related to motor vehicle use.

The organization of motor vehicle departments has not followed a uniform pattern. While usually set up under the direction of a commissioner of motor vehicles, its location within state governmental organization often varies. In California, Wisconsin, Vermont, New Hampshire, Massachusetts, Connecticut, New Jersey, Maryland, District of Columbia, Virginia, North Carolina, Florida, Mississippi, Rhode Island, and West Virginia, the motor vehicle department has equal status with other state departments. Oregon, Nevada, Wyoming, South Dakota, Minnesota, Illinois, Indiana, Michigan and Maine, however, have motor vehicle units established under the department of state. In the early period virtually all motor vehicle departments had been operated in connection with the secretary of state's office. In Arizona, North Dakota, Nebraska, Kansas, Texas, Ohio, South Carolina, and Delaware, legislatures have created motor vehicle bureaus under the highway department. On the other hand,

the lawmakers of Washington, Utah, Colorado, New Mexico, Oklahoma, Missouri, Arkansas, Louisiana, Kentucky, Tennessee, Alabama, Georgia, Pennsylvania, and New York have placed their motor vehicle bureaus under the direction of a revenue department. As traffic accident precaution problems became more acute, Iowa and Idaho established public safety departments and placed many of the functions performed in connection with motor vehicle administration under this type of organization. Montana, however, is unique in that it established its motor vehicle department under the direction of the warden of the state penitentiary in order to take advantage of prison labor.

Organization within motor vehicle departments varies radically depending upon the state legislature's conception of administration. However, almost all include one or more of the following units: title, registration, driver licensing, financial responsibility, accident records, safety and public safety education, dealer licensing, and vehicle inspection. In large states such units are often grouped under divisions of administration, enforcement, drivers' licenses, and registration.

At the present time, thirty-one states and the District of Columbia have adopted a title law to protect the ownership of motor vehicles and to improve and facilitate the procedure of registration. Many states also issue titles on trailers. The first certificate-of-title law was adopted by Maryland in 1920. The value of a title law allegedly lies in its ability to establish ownership of the vehicle as a means of preventing theft and fraud.

Title departments receive from the individual evidence of ownership in the form of a manufacturer's certificate of origin or dealer's bill of sale. The state in turn issues a title, certificate of ownership, or bill of sale in lieu of the original documents. In states where title laws exist, the records of vehicle ownership are centrally located. Information with respect to liens and encumbrances must be filed with the department as a protection to purchasers of vehicles against third parties. Title departments usually maintain cross indexes to identify both vehicles and owners. These files generally include a motor number file for reference to the vehicle, the title number file for reference to the departmental record, and the alphabetical file for reference to the owner. In all title departments, procedures have been established for checking transfer sales of vehicles to detect stolen or encumbered vehicles and to insure that accurate records are maintained.

In states that do not have title departments, applications for vehicle registration are designed to serve somewhat the same pur-

pose as a title. In these states, however, proof of ownership requirements are less rigid. A person registering a vehicle in his own name is required to submit only a bill of sale as evidence of ownership. Ownership of a vehicle is, in a non-title state, often difficult to ascertain. To insure that no encumbrance is outstanding, it is frequently necessary to contact county and local governmental agencies to be sure of the satisfaction of liens.

Registration of vehicles in title states requires that the applicant submit proof of ownership in the form of a document evidencing his right of possession in the vehicle in the event he is not himself the legal owner.

Registration in all states, however, is effected through the individual's preparation of an application describing the vehicle and providing other information required by the proper authorities.

In addition, the applicant is required to pay the specified fees. Some of the common fee bases are: flat, net weight, gross weight, shipping weight, horsepower, percentage of value plus stated fee increments on each additional 100 pounds, percentage of factory list price and fees based on number of years registered plus additional fee for increments of 100 pounds over certain weight. The lack of a uniform basis for assessing fees has been recognized by the American Association of Motor Vehicle Administrators and a committee of that organization is now attempting to establish a formula that will be acceptable to all states.

The preparation of departmental records for the application of vehicle registration is handled in a number of different ways. No two states employ exactly the same method. All states, however, maintain certain basic records to identify the vehicle and its owner. These records include the registration number file, the alphabetical file, and engine number file. Inquiries originating from police sources usually require reference to the registration number file, although the other two files are frequently necessary. Inquiries from individuals generally require reference to the registration number file and name file, and those from dealers to the engine number file.

The files in a motor vehicle department serve many purposes. They materially aid the police in tracing auto thieves and hit-and-run drivers; they provide motor vehicle dealers with a means of checking the ownership of vehicles before taking them as "trade-ins."

In 1935 the Interstate Commerce Act was amended by the 74th Congress, adding Part 2 (cited as Motor Carrier Act, 1935) pertaining to the transportation of passengers or property by motor carrier in interstate or foreign commerce. The Act created the Bureau of Motor Carriers and gave it certain quasi judicial and administrative

functions. This action marked the first entry of the Federal government into the field of motor vehicle administration.

The Bureau under its authority established several procedures applicable to carriers and drivers coming within its jurisdiction. It has prescribed qualifications and hours of service for drivers; required reporting of accidents; established rules for driving vehicles; and specified certain parts and accessories for the safe operation of vehicles. While the Bureau's area of operations is confined to the regulation of vehicles in interstate traffic, it nevertheless has had a profound effect on motor vehicle administration and traffic safety techniques.

The licensing of drivers began at approximately the same time as the registration of vehicles. Driver license divisions are usually charged with the responsibility of examining all applicants for original driver licenses and of renewing those licenses which have expired. In the course of issuing driver licenses, the department collects a fee that is generally intended to defray the expenses of the driver license system and to provide facilities requisite to a good examination. A further and equally important duty of these divisions is the suspension and revocation of the licenses of persons guilty of certain types of violations.

The primary purpose of driver licensing lies in determining the operator's skill and knowledge of those laws pertaining to the operation of a vehicle. The issuance of the license and the establishment of a record is incident to the effective control of the driver. Driver records play an important part in the program of controlling drivers who have accumulated bad records.

Driver license examinations fall into three classes—those given new drivers, those given periodically to drivers already licensed, and the reexaminations of drivers for cause.

The vast majority of the states require original applicants for driver licenses to take a license examination. The examination requires the operator to give certain information concerning his physical condition; to show his ability to recognize road signs; to meet certain standards of vision; and to demonstrate his knowledge of road rules and exhibit his skill in driving.

Because of limitations in personnel and budget, few states have been able to provide all drivers with satisfactory periodical renewal examinations. While motor vehicle administrators believe periodical renewal examination should be employed, all but a few states have been forced to forego this procedure and in its stead subscribe to the renewal of license with either a cursory examination or no examination at all. Under this method of operation, control of the

driver has been accomplished through revocation and suspension procedures based on the record of the operator's arrests, warnings, convictions, and accidents.

The organizational plan of most driver license bureaus is elementary. The administrative head of the bureau is known as the director, commissioner, or registrar. His function is to coordinate the work of the several sections comprising his department. The first section is supervised by a chief examiner who is responsible for all matters pertaining to drivers' examination. The second section is supervised by an office or production manager who is responsible for the production of licenses, filing of records, and other matters pertinent to routine office management. The third is a driver-improvement section, which is supervised by a chief hearing clerk or judge who is responsible for actions and hearings in connection with the revocation and suspension of driver licenses.

Some bureaus have accident record sections or statistical sections as a fourth important branch. All but three states require the reporting of accidents, and in many the analysis of such reports is a function of the motor vehicle department. Because of the interest of the motor vehicle administrator, the highway engineer, and the enforcement officer in accident reports, the location of the bureau performing the analytical work may be placed in any one of the three interested agencies.

The engineer's use of accident reports is confined largely to an analysis of occurrences at particular locations. The enforcement officer also uses accident reports on the basis of location for selective enforcement techniques. However, since both these agencies are concerned only with historical use of such reports it has been found expedient for the motor vehicle department to receive the reports originally, and to provide analyses of them for the other interested agencies.

Safety responsibility, as it is now called, is a relatively new development in motor vehicle administration.[1] Safety responsibility as added to the Uniform Vehicle Code in 1934 incorporates standard requirements in respect to filing proof of financial responsibility. Safety responsibility laws require any person whose license has been suspended or who has been convicted of certain traffic offenses to furnish proof of financial responsibility before his license may be restored. In addition, the motor vehicle commissioner is required to suspend an operator's or chauffeur's license and the registration of any motor vehicle owned by any person who fails to pay a traffic

[1] Report of Committee on Laws and Ordinances, President's Highway Safety Conference (Washington, 1946), 44.

accident judgment within a stated number of days after it becomes final. Such suspensions remain in effect until the debtor has paid the judgment up to certain specified amounts and has filed proof which may be given either by obtaining the motor vehicle liability policy or by furnishing a bond or by depositing money or securities with the commissioner. Authority is vested in the commissioner to release such proof at any time after three years, provided no action on the traffic accident claim is pending, no traffic accident judgment remains outstanding, and the person involved has not been convicted within the period for any offense requiring suspension or revocation of license. Since 1944 many states have imposed additional security provisions. One of these requires a report to the commissioner by those involved in traffic accidents in which any person is killed or injured or in which the damage to property or any one person exceeds a stated amount. The new laws provide that the commissioner shall, within sixty days after receiving such report, suspend the license of each operator and all registrations of each owner of a vehicle in any manner involved in the accident unless such operator or owner, or both, shall deposit security in a sum which shall be sufficient in the opinion of the commissioner to satisfy any judgment for damages.

Certain exceptions, however, are made to the foregoing requirements. For example, the posting of security is not required from an operator or owner who had in effect, at the time of the accident, an automobile liability policy. Neither is such deposit of security required of any person who qualifies as a self-insurer. Moreover, there is no deposit of security in the event of an accident where no injury or damage is caused to the person or property of any one other than the operator or owner. Owners of parked vehicles and owners of vehicles being operated without express or implied permission are also exempt. Provision is, of course, made for the commissioner to administer the various details incident to funds and records deposited with him.

Because motor vehicle departments have direct contact annually with millions of persons, many of them have established public relations bureaus as a means of providing service in connection with registration and driver licensing procedures. Most departments have found it necessary to carry on a continuous campaign of public education to acquaint drivers with their policies and rules and regulations. Public relations counsel cooperate closely with all division chiefs and bureau heads in establishing policies for the department and in keeping the public informed of motor regulations. Newspapers, periodicals, and radio provide the main outlets for information.

Periodic inspection of motor vehicles grew largely out of campaigns to "Save a Life" instituted by proclamations of state governors, and sponsored by the Eastern Conference of Motor Vehicle Administrators.[2] Owners of motor vehicles were asked to present their automobiles at designated garages for a complete inspection and to repair any detectable defects. Later, in 1929, Pennsylvania, Maryland, and Massachusetts were the first states to enact laws for state-wide periodic inspection of motor vehicles.

Three major types of official inspection systems have evolved: state or municipal owned and operated stations, both fixed and portable; private stations appointed by the state; and combination of officially owned and operated and state-appointed stations.

Prior to the active entry of our nation into World War II, more than 8,500,000 motor vehicles were regularly inspected from one to four times a year in seventeen states and fifteen cities.

At the present time the following states have state-owned and operated stations: Connecticut, Delaware, District of Columbia, New Jersey, South Carolina, and Washington. Private stations appointed by states are operated in Colorado, Maine, Maryland, Massachusetts, New Hampshire, New Mexico, Pennsylvania, Vermont, and Virginia.

To guide this development and to provide for uniformity, the National Conference on Street and Highway Safety has included, as a part of Act V of the Uniform Vehicle Code, an article pertaining to vehicle inspection. This alone, however, did not give sufficient impetus to the movement. Since that time, a significant milestone has been attained by the development of the American Standards Motor Vehicle Inspection Code and Manual. The code sets forth minimum standards for safe performance of motor vehicles. A manual designed to aid states and municipalities in putting the code into effect and to foster standard procedures for setting up and operating inspection stations has also been developed.

In the course of development of motor vehicle administration and the interstate use of vehicles, reciprocity in the matter of registration, sizes and weights of equipment, drivers' licenses, and taxation practices have become an important consideration. Because of the differences in state laws, some states sought to exclude vehicles from other states. This resulted in retaliatory measures being taken against the state that had denied the use of its roads to a registrant from another state.

The impact of this impossible situation was one of the underlying reasons for the banding together in 1921 of the motor vehicle depart-

[2] Report of Committee on Motor Vehicle Administration, President's Highway Safety Conference (Washington, 1946), 11.

ments in the eastern section of this country for the purposes of "considering the question of guiding future legislation and administration of motor-vehicle laws so as to procure uniformity and reciprocity." [3]

At the first meeting of the newly organized conference, consideration was given to such problems as operators' licenses, right of way, rules of the road, regulation of commercial motor vehicles, uniform lighting, and the sharp increase of persons operating vehicles while under the influence of liquor.

Meetings of this group also considered the accident problem and in 1924 the Department of Commerce was urged to call a national conference to consider the matter of uniform traffic laws. This action resulted in the formation of the Conference on Street and Highway Safety which developed the Uniform Vehicle Code now widely accepted as model traffic legislation.

Meanwhile, the interstate movement of motor vehicles had grown to the extent that persons were traveling from coast to coast with a complete lack of knowledge of state traffic laws.

One of the first recommendations of the National Conference on Street and Highway Safety was the recognition of motor vehicle departments as such and a definition of their jurisdictions. This particular recommendation was responsible for great progress in drawing together, within the respective states, those elements which previously had been decentralized under various state departments.

In October 1932, the Eastern Conference of Motor Vehicle Administrators, which had expanded to include twenty-two states, the District of Columbia, and Provinces of Canada, recognized the need for a national organization to meet the many problems that were developing both in motor vehicle administration and traffic accident prevention procedures throughout the country. As a result, the American Association of Motor Vehicle Administrators was organized and the same program that had been developed by the Eastern Conference of Motor Vehicle Administrators was adopted and refined.

In the field of traffic safety, the Association fostered the adoption of uniform laws and regulations governing drivers' licenses and the equipment and operation of motor vehicles; the uniform standards and practices of enforcement by police and uniform statutes for enforcement by judicial authorities; the promotion of educational campaigns in the interest of public safety; the technical studies in the development of traffic control standards; the proper selection and training of department heads in the various fields of motor vehicle administration; and the cooperation with Federal agencies and

[3] *ibid.*, 2.

private organizations in studies relating to safe highway transportation.

In December 1940, at the request of the Secretary of War, all motor vehicle departments joined with state highway and police officials and the Public Roads Administration in forming the National Highway Traffic Advisory Committee to the War Department.

The purpose of this organization was to cooperate with and assist the Army in such matters as the expediting of military movements over the highways; meeting traffic problems created by large concentrations of troops and industrial workers; selecting and training Army personnel to drive Army motor equipment; making available to the civilian driver records of men in the military service; giving highway and routing information; and making an inventory of all commercial and motor vehicle equipment, both privately and publicly owned, in the United States.

The complete facilities of the state motor vehicle departments and the Association's national headquarters were made available to the War Department to carry out the full program.

In 1944, looking forward to the end of the war, the Association developed its present program. This 10-point program includes the following:

1. Adoption of the Uniform Vehicle Code by all member departments.
2. Uniform reciprocity between all states for vehicles in interstate operation.
3. Adoption, in states where needed, of approved minimum flooring of maximum sizes and weights for commercial vehicles.
4. Adoption of Association's approved standards for driver examinations and examination procedures by all states.
5. Adoption of uniform vehicle inspection law by all states.
6. Members to provide leadership in pedestrian regulation and control program in each state.
7. Members to procure establishment of training courses in normal schools and colleges for driver-training teachers in all states.
8. Members to procure incorporation of required driver-training courses in all high schools in all states.
9. Close cooperation between state administrative and state enforcement officials.
10. Cooperation of all states with Highway Traffic Advisory Committee to the War Department, Public Roads Administration, and other Federal agencies.

With the cessation of hostilities, motor vehicle commissioners recognized that release of wartime restrictions on the use of vehicles

would result in increased traffic deaths, if positive control methods were not adopted. Accordingly, at the 1945 conference of the Association, the motor vehicle administrators called upon the President of the United States to "call a conference of responsible, public and civic leaders to mass nationwide support for our effort to provide safe and efficient highway traffic." In May 1946, administrators from forty-six states took an active part in the resulting President's Highway Safety Conference and contributed materially to individual committee reports and to the action program that was adopted. Subsequently, the administrators in twenty states have directly interested themselves in Governors' conferences. Thus as an organized group, the motor vehicle administrators have provided definite leadership in promoting traffic safety.

Motor vehicle administration, which affected 8,000 registered owners in 1900, had grown to a point where it concerned some 30,086,189 owners and 45,000,000 operators in 1944.[4] Along with this growth in numbers had come a multiplicity of interests and responsibilities. Work that began as a "sideline" in a corner of the secretary of state's office has developed into an agency of government touching the lives of millions of persons in the nation.

[4] "Motor Vehicle Registration in the U. S. by States, 1900-1946," Table MV-201, Public Roads Administration.

45 JUDICIAL ADJUDICATION OF TRAFFIC VIOLATIONS

BY JAMES P. ECONOMOS

"The creaking judicial machinery of our time is antiquated and moves too slowly: it has proved to be somewhat of a drawback in the development of efficient traffic law enforcement." [1] Thus does one authority approach the subject of the effectiveness of the judicial system in dealing with traffic violators. Another authority presents the following viewpoint: "What needs to be emphasized, however, as one soon sees in reviewing the course which these courts (referring to small cause courts which usually possess jurisdiction over traffic violations) have taken in a quarter of a century of development, is that personnel is much more important in the long run than organization and mechanics of operation, and that the strongest magistrates who can be secured are none too good for them. Good lawyers will be well worth their salaries in these no less than in other courts." [2]

Poorly organized courts or unfit judges produce equally disadvantageous results. It is well known that judicial tribunals exercising jurisdiction over traffic violations and popularly known as "Traffic Courts" affect to a substantial extent the effectiveness of all traffic law enforcement. Sound and effective administration of justice by these courts can accomplish much in promoting a more efficient use of the highways through increased respect for the laws governing their operation.

Just as the rapid development of motor vehicle transportation created demands for a more extensive and improved highway system, so did the increase in traffic violations committed by some of the forty-five million motorists [3] tax the antiquated processes of the judicial system. A system designed to handle only a comparatively small number of cases daily was gradually but unsuspectingly con-

[1] Chapter on "Criminal Law and Automobiles" prepared by the late Professor Newman F. Baker for the *Accident Investigation Manual* published by the Northwestern University Traffic Institute, 1941, 65.

[2] Roscoe Pound, *Organization of Courts* (Boston, 1940), 268. This is the first volume in the Judicial Administration Series published under the auspices of the National Conference on Judicial Administration.

[3] *State Traffic Law Enforcement* prepared under the direction of the Committee on Straight Traffic Law Enforcement Manual by George E. Miller and David M. Baldwin, as a joint project of the American Association of Motor Vehicle Administrators, International Association of Chiefs of Police, and the National Safety Council, 1944, 1.

fronted with overloaded case dockets and insufficient personnel. In the larger cities it has not been unusual for a court to dispose of over 500 cases in one day and even as many as 1,000.[4] The impact of rapidly expanding dockets considerably disrupted the efficiency of judges operating under comparatively inflexible procedures. It is unfortunate that the traffic courts, like all other elements in traffic law enforcement, were unprepared. Only time can reveal whether or not they will be able to recapture their rightful position in the judicial sun.

THE GENERAL PROBLEM

The general effort to assure the movement of vehicular traffic over the nation's highways with maximum efficiency and minimum traffic hazards has presented many problems. Those touching the court are predicated upon the laws and regulations enacted by the states and municipalities.

Ever since the first traffic code in the world was adopted by New York City in 1903,[5] there have been many conflicting regulations and laws adopted. A great deal must be accomplished before the traffic courts of the nation will be able to operate under uniform statutes and model ordinances. Former United States Supreme Court Justice Owen J. Roberts, chairman of the Committee on Laws and Ordinances of the President's Highway Safety Conference, reports: "In order to better control the operation of vehicles and to accomplish a reduction of accidents, adequate and uniform motor vehicle laws and regulations are essential. While appropriate enforcement, educational, and judicial procedures must be employed, they are of necessity dependent upon a sound basis of traffic laws and ordinances, explicitly and clearly stated, which will commend themselves to our people." [6] The importance of uniform legislation cannot be minimized because these define the violations coming before the courts. A thorough investigation of this subject was made by Justice Roberts' Committee. It has also been covered in a preceding chapter of this book.[7]

The next important consideration arises from the courts' application and interpretation of these laws in adjudging cases presented

[4] George Warren, *Traffic Courts* (Boston, 1942), 112. This is the fourth volume in the Judicial Administration Series edited by Roscoe Pound, Dean Emeritus of the Harvard Law School.

[5] *The Evolution of a Uniform Road Traffic Control Code with Safety Rules for Pedestrians,* published by the Eno Foundation for Highway Traffic Control, Inc. (Saugatuck, 1943).

[6] See Report by Committee on Laws and Ordinances of the President's Highway Safety Conference (Washington, 1946).

[7] See the essay by J. Allen Davis on "Motor Vehicle Legislation."

against traffic law violators. This is complicated somewhat by the general inapplicability of the processes of criminal law to the vast majority of "non-criminal" violations.

Many, including judges and prosecutors, have become aware that the courts are hampered in this function because the existing organization of courts left much to be desired in the handling of the average traffic cases. The courts' attempts to correct violators through the imposition of penalties provided by law must also be considered. Efforts to improve the traffic courts should be examined. The better selection of judicial personnel should be encouraged.

In the last analysis the public's attitude toward traffic law enforcement will control to a considerable extent the courts' performance. Although the better courts will help the public acquire the right attitude, there are too many which will not exercise their influence for good.

TRAFFIC VIOLATIONS

Only traffic violations in the Uniform Vehicle Code [8] will be enumerated because of space limitations. Act V of the Code which regulates traffic on highways provides that every violation is a misdemeanor unless otherwise declared.[9] Those declared to be otherwise because of penalty differentials or to be felonies are set forth in the following sections: (39) Failure to stop after accident involving personal injuries or death and commonly known as "Hit and Run." (53) Negligent homicide. (54) Driving while under the influence of intoxicating liquor or drugs. (55) Reckless driving.

Speeding is included within the general classification of misdemeanors.[10] Other misdemeanors include, inter alia, the following violations: [11]

1. Failure to obey police officer with authority to direct, control or regulate traffic.
2. Failure to obey traffic signs and signals.

[8] Uniform Vehicle Code consists of five parts:

(I) Uniform Motor Vehicle Administration, Registration, Certificate of Title, and Anti-theft Act. (II) Uniform Motor Vehicle Operators' and Chauffeurs' License Act. (III) Uniform Motor Vehicle Civil Liability Act. (IV) Uniform Motor Vehicle Safety Responsibility Act. (V) Uniform Act Regulating Traffic on Highways. These and the Model Traffic Ordinance have been prepared by the Committee on Laws and Ordinances of the National Conference on Street and Highway Safety. For more detailed information, see the essay by J. Allen Davis on "Motor Vehicle Legislation."

[9] Uniform Vehicle Code, Act V, Section 23 and Section 181 (A).

[10] See Uniform Vehicle Code, Act V, Article VI.

[11] See Uniform Vehicle Code, Act V, Sections 33, 37, 38, 40, 42, 43, 63-103, 110-113, 123-156.

3. Displaying unauthorized signs, signals or markings.
4. Interference with official traffic control signals.
5. Failure to stop after accident causing property damage.
6. Failure to drive on right side of road except when otherwise authorized.
7. Overtaking vehicle on wrong side.
8. Passing in a "no-passing zone."
9. Following too closely.
10. Failure to turn properly.
11. Turning on curve or crest of grade.
12. Starting parked vehicle while movement cannot be made with reasonable safety.
13. Failure to give signal of turn.
14. Failure to yield right of way.
15. Pedestrians failing to observe traffic control signals at intersections.
16. Improperly operating bicycles and play vehicles.
17. Improperly passing street cars.
18. Driving through safety zones.
19. Illegal parking.
20. Improper equipment or lack of equipment on vehicles.

There are other violations set out in Act V and in the other four Acts of the Code but these are not considered further in this connection.

Permissive regulation by local authorities is set out in the Code and, in conformity therewith, the Model Traffic Ordinance makes provisions for additional traffic violations. Parking violations and others designed to control congestion will be enforced under the latter.[12] These ordinance violations are also considered to be misdemeanors.[13]

[12] In Illinois the problem of enforcing parking violations was simplified by a holding that in a prosecution for parking near a fire hydrant, the city established a prima facie case by a mere showing that the defendant owned the automobile which was illegally parked, under a statute making the owner liable for the violation even though he did not personally park the car. *City of Chicago* v. *Crane,* 49 N.E. (2nd) (Ill. App.) 802.

[13] In criminal law one deals with felonies and misdemeanors and the Code has recognized this classification. The distinction between the two is well stated by Professor Baker in *Accident Investigation Manual,* supra.

"The criminal law, of course, existed hundreds of years before anyone dreamed of the automobile, and the automobile cases must conform to the criminal law as we have it—a product of centuries of legal evolution. . . . One thing which characterizes traffic offenses is the fact that while at common law a

New York has attempted to avoid the implication of criminality in traffic violations by providing an additional classification. Although retaining the felony and misdemeanor as crimes, it created a new class known as "Traffic Infractions." [14] While an improvement in terminology, there has been no rush by other states to adopt the new term.

Some concerned with traffic law enforcement prefer to refer to violations as being either "moving" or "non-moving." This simplifies the distinctions between the hazardous movements and the comparatively non-hazardous actions. The "moving violations" receive or should receive immediate attention from enforcement officers and courts.

Uniformity of traffic laws requires uniform enforcement before some modicum of uniform application of judicial interpretation can be achieved. An experiment in uniform enforcement is being pursued in five cities in Michigan. An explanation of the plan follows:

"The purpose of the uniform enforcement policy is to give to the police for the first time a basis by which the individual officer may witness a violation, determine that it falls into a particular class, and be given positive direction as to what action, if any, his department wishes him to take.

"The system is for administrative use only, for training, for determining officer action, and court action. . . . The system converts traffic violations to simple, illegal maneuvers which constitute violations. It then . . . gives them a hazard rating. If the rating is below a certain level the violation notice ticket which the driver receives will result in its serving as a written warning if it is his first offense in the pre-

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criminal intent, i.e. mens rea or guilty mind, usually has to be proved, this is seldom a necessary element in statutory regulations in the traffic field. Most automobile offenses are petty offenses and they are adopted as a means of protection to the public. The statutes are framed so that the acts prohibited are committed 'at the peril' of those coming within the statutory provisions. Laws condemning speeding, failure to have a license, defective equipment, operating without proper lights, etc., all must be obeyed and no excuse is allowed, e.g. that the offender did not have criminal intent or that he did not know that he was violating the law.

"In general, crimes mala prohibita (prohibited wrongs) are punished whether or not there is criminal intent, but on the other hand crimes mala in se (morally wrong) usually require proof of an intent. Assault and battery, criminal homicide and reckless driving with an automobile are charges which often grow out of accident cases. There the prosecutor meets up with the embarrassing fact that these offenses may require proof of criminal intent because they are considered mala in se."

[14] See Chapter 59 entitled "Vehicle and Traffic Law" in New York Laws of 1929 and subsequent amendments.

ceding twelve months—or a trip to court if it is his second offense. If the rating is above this level the violation notice ticket will result in a trip to court. . . . To simplify the problem of developing a uniform policy this first application has been purposely restricted to the six principal violations which contribute to some 80% of the accidents and to six conditions which make these violations even more dangerous. . . .

"To bring about uniformity and make possible a rating system it was necessary to break down each of the six violations into three specific driving maneuvers which were clear-cut and not subject to more than one interpretation. This produced 18 maneuvers on a chart which became a check list on a traffic ticket thus not requiring the officer to memorize them. A careful study of words produced 31 specific terms upon which everyone could agree." [15]

Judges and prosecutors in the five Michigan cities are enthusiastic about the Uniform Enforcement plan because it enables them to dispose of violators on a more accurate basis. The plan may well be adopted elsewhere.

Traffic violations have also been classified in their role as contributing factors to the causes of accidents. A detailed summary of these was set out in the report on "Motor-Vehicle Traffic Conditions in the United States" made to Congress in 1938 (House Document 462, 75th Congress, 3rd Session). Accidents are a symptom of inefficient use of the highways. One of the methods available for the treatment of persons committing traffic violations is to prosecute them in the courts with jurisdiction over traffic offenses.

TRAFFIC COURTS

The nation's courts have seen a remarkable rise in cases arising out of violations by motorists. They now comprise a substantial portion of their judicial business both in civil and criminal cases. In the criminal field studies indicate that as much as seventy-five per cent of the court's work may arise from traffic violations.

[15] Maxwell Halsey, "The Uniform Enforcement Policy Regarding Traffic Regulations," *Journal of Criminal Law and Criminology*, July 1946, XXVII, 158. Since the introduction of this policy, 31 cities in Michigan have accepted the plan. Shortly after January 1950, 57 cities, comprising all the cities, towns, and villages in Wayne County except Detroit, will inaugurate the use of the uniform enforcement policy. The uniform traffic ticket, patterned after the Michigan ticket and combining the use of the original as a complaint, has been adopted in New Jersey under a rule of the Supreme Court effective January 1, 1949. See the article by Chief Justice Arthur T. Vanderbilt, "New Jersey's Traffic Court Program," *Public Safety*, June 1949. Every law enforcement officer in New Jersey issues the same type of complaint.

Despite this phenomenon, the nation's traffic courts are still operating, on the whole, under organizational and personnel difficulties existing at the time the automobile was first used. In Dean Roscoe Pound's critical analysis of court structure, another handicap which continues to confuse the authorities was disclosed. He reveals: "Want of cooperation among public functionaries established to do a part of a whole task of administration is characteristic of the American policy of the last century. . . . It has been, and to no little extent still is, manifest in lack of cooperation of administrative officials in the same locality with each other, in the lack of cooperation between local prosecutors and local courts, in friction between local courts and local administrative officials and in the lack of cooperation of court with court or even of judge with judge in the same local court." [16]

Furthermore, traffic cases in most states are heard by a miscellaneous and heterogeneous group of courts. George Warren, the author of *Traffic Courts,* stated that traffic cases in New Jersey can be heard before courts variously styled as Municipal, Police Recorder, Quarterly, District, County, Special Session, Oyer and Terminer, Justice of the Peace, and Commissioner of Motor Vehicles. All of these courts were abolished with the adoption of a new state constitution and the enactment of legislation permitting such action. Now these courts have been replaced by a system of county district courts and municipal magistrates courts. Other states have varying numbers of courts possessing jurisdiction over traffic cases with most states indicating that at least four different courts are available. Tennessee has only two kinds of courts hearing traffic violations. Forty-six thousand justices of the peace in thirty-eight states also possess trial jurisdiction over traffic cases. Although it is well known that a small percentage are actually trying traffic cases, nevertheless the number permitted to try such cases is out of all proportion to the personnel requirements of the situation. This complicated system of courts is sufficient to illustrate the tremendous inefficiencies in the use of judicial manpower. The problem is further complicated in that efforts to improve this phase of the system are enmeshed with constitutional limitations.

In the early days of the automobile the traffic cases were tried with all other cases appearing on the criminal docket. Today practically the same courts are still plagued with criminal procedure. Research indicates there are many differences between criminal cases and traffic cases.[17]

[16] Roscoe Pound, *Organization of Courts,* 254.

[17] George Warren, *Traffic Courts,* 33-34. The variations are outlined as follows:

It has also been stated by one authority that the reason traffic law is classified as a branch of criminal law, is because it is not civil, and if it is not civil, it must be criminal. This writer further comments forcibly:

"Actually, however, in the whole long list of acts which constitute violations of the law, drunken driving and hit-and-run driving, and some instances of reckless driving are the only offenses which can realistically be considered true crimes. And yet, we have lodged jurisdiction over traffic offenses in courts which are essentially criminal courts, courts which spend a large part of their time grinding out thousands and thousands of cases which are essentially criminal, and thereby acquiring a point of view, a psychology, if I may use that much abused word, which is unsuited to the administration of traffic laws. A Judge who adjusts his thinking to the problems presented by strong-arm bandits, prostitutes, gamblers, bootleggers, chronic alcoholics, knife wielders and bar-room brawlers is psychologically off guard when in the midst of the flotsam and jetsam he is suddenly confronted by the dear old lady who has inadvertently run through a stop sign or has neglected to put a nickel in a parking meter. And the impression which the dear old lady

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"1. There is almost always a single issue involved without question of degree or technicality.

"2. The judge is given no extraneous or impartial testimony to aid his decision, but must decide whether the defendant's story raises a reasonable doubt. This means, in the majority of disputed cases, especially non-accident, that the judge must rely as much upon character and appearance as upon facts.

"3. The traffic violator is a criminal in the sense that he has breached a law made for the benefit of society, but in the case of minor violations he will not respond to the treatment usually given lawbreakers in other fields, such treatment tending to arouse antagonism rather than future cooperation and law observance. This observation does not, of course, apply in drunken driving or hit-and-run charges.

"4. Except for some cases involving accidents, traffic violations do not necessitate long, complicated or drawn-out trials. This permits rapid adjudication and the proper disposal of a number of cases far beyond that possible in any other criminal field.

"5. Traffic law enforcement, like other aspects of traffic control, calls for uniform treatment over large areas. The identity of the fundamental problems involved makes treatment on a uniform basis extremely desirable. Furthermore traffic courts must cooperate with the state motor vehicle administration through uniform procedures which allow information vital for the state administration to be readily available to the latter.

"6. Cooperation with the local and state police in the maintenance of records of offenses, convictions and punishments is important to such departments as well as to the court."

carries home with her, after a visit to a court vested with such varied jurisdiction, is unfortunate." [18]

To meet this situation the authorities have established separate traffic courts [19]—traffic court branches of municipal courts, etc.,[20] separate traffic court days and traffic court sessions apart from other cases. Night court sessions have also been held. This has permitted some degree of specialization by the judge.

In traffic cases the judge should definitely know something about traffic safety, policing, control, and engineering. He should be aware of the educational aspects of his work. He must become familiar by training and experience with the present-day problems of traffic law enforcement. He should understand the relationship between violations and accidents, driver deficiencies and accidents, equipment failures and accidents, and other factors and accidents.

This applies with equal force to the prosecutor. He should also arrange, in close cooperation with the enforcement officers, for time to make the proper preparation for trial through interviews and examinations of written reports and accident records. He should always let the arresting officers know what he needs to complete his prosecution. He should certainly avail himself of all scientific proof pertaining to the case at hand.

It makes no difference from the standpoint of traffic law enforcement whether the judge tries one traffic case a week or 1,000 each day. The circumstances demand that he be prepared to do the best job that he is capable of performing in each case. Consider this from the standpoint of the defendant. He is usually standing alone in strange surroundings, apprehensive and self-conscious, and confronted with the representatives of the public, a uniformed police officer and a prosecuting attorney ready to present the evidence against him. To the court and court attachés, it may be only one of a hundred cases of that day; to the individual at the bar of justice, it is an all-important case, which may have an influence throughout his life.

This is particularly true because appeals in traffic cases are rare

[18] James W. Hodson, "Improving the Administration of Traffic Courts," *Washington Law Review and State Bar Journal*, January 1944, XIX, 95. See also foreword by Arthur T. Vanderbilt, in George Warren, *Traffic Courts.*

[19] Separate traffic courts are provided by statute for Danbury, Conn.; Baltimore, Md.; and Nashville, Tenn.

[20] Traffic court branches have been established in the Municipal Court of Chicago, Magistrate Courts of New York and Philadelphia, Recorder's Court of Detroit, Municipal Court of Los Angeles, Municipal Court of San Francisco, and several other cities.

and not pursued unless a serious charge is involved. It is doubly important that the impression left with the violator be such as will create respect for the judicial process quite apart from respect for its punitive powers. This has been accomplished in several cities by providing dignified and impression courtrooms and adequate physical facilities. Although everyone recognizes the importance of creating a proper feeling of respect for law and order on the part of the defendants and the general public, too few realize the effect created on the judge. A tremendous influence is constantly operating on the mental attitude of the traffic court judge presiding in the midst of a pleasant judicial atmosphere created by a dignified and impressive courtroom. The judge's morale, pride, and respect for his profession and judicial position are improved. He will unconsciously communicate this attitude to everyone in the courtroom and improved decorum and respectful attitude will be his immediate reward.

CORRECTION OF VIOLATORS

The primary aim of the traffic court should be to impress violators with the need for traffic law observance rather than to penalize. The money fine, the jail sentence, or a combination of both are generally available to all courts. Typical penalties are set forth in section 181 (b) of Act V of the Uniform Vehicle Code, which reads as follows: "(b) Every person convicted of a misdemeanor for a violation of any of the provisions of this act for which another penalty is not provided shall for first conviction thereof be punished by a fine of not more than \$100 or by imprisonment for not more than 10 days; for a second such conviction within 1 year thereafter such person shall be punished by a fine of not more than \$200 or by imprisonment for not more than 20 days or by both such fine and imprisonment; upon a third or subsequent conviction within 1 year after the first conviction such person shall be punished by a fine of not more than \$500 or by imprisonment for not more than 6 months or by both such fine and imprisonment."

The failure of fines and penalties to act as a sufficient deterrent has been apparent from the time traffic violations were first penalized. Certainty and consistency of punishment, together with adequate and proper penalties will do much to solve the problem. Driver's license suspensions and revocations have accomplished a great deal of good in supplementing the action of the court. Drivers often regard such actions as a definite hardship.

The widespread variations in fines reported by Warren in *Traffic Courts* still exist. Many traffic court judges are striving to find a better

yardstick for their judgments. The uniform enforcement policy being used in Michigan may be one of the answers. The use of records of previous convictions is helpful. One judge in assessing his punishment advocates the use of records, generally prohibited as evidence in the trial, such as the record of traffic court penalties, attendance at traffic schools, previous accidents, previous motor vehicle convictions and other previous misdemeanors.[21]

The imposition of money fines can be effective only when the amount involved represents a definite burden on the violator. The Connecticut judge who recently assessed a 3-cent fine for reckless driving and passing a red light was certainly attempting to achieve a record for leniency. The same is true of another Connecticut judge who imposed the lowest fine on record—$3.00—for driving a motor vehicle while under suspension.[22] At the other extreme is the judge who assesses the maximum fine in every case. Too strict a policy on fines is just as bad as being too lenient. There is a middle ground. No formula is available for the use of the judges. It requires experimentation plus a careful review of the effectiveness of penalties assessed in the past. Intelligent application to the task is required. An increase in fines is almost invariably accompanied with decreased accidents.

Uniformity in fines over a large area is desirable. Several attempts in this direction are now proving helpful in securing voluntary compliance.

States permitting the judge to use probation have created a tool of real value in the hands of the conscientious judge. Under its probationary powers the court can utilize provisions not ordinarily available in the law creating the offense and specifying its penalty. It can offer probation upon certain conditions for a stipulated time. In Cincinnati probation is used with restriction of driving privileges, surrender of license plates, attendance at traffic schools, etc.[23]

Jail sentences for traffic cases are infrequent. Some judges feel that the public is not ready to support such punishment. In Salt Lake City the judge has consistently imposed a jail sentence on all violators with two previous convictions for a moving violation within the last twelve months. On first offense of driving while under the influence of intoxicating liquor, often a short jail term is imposed

[21] Remarks of Traffic Court Judge Guy Shearer of Louisville, Ky., made in Chicago before the National Safety Congress, October 8, 1946.

[22] Information supplied by William M. Greene, Director of Connecticut Highway Safety Commission in bulletin "*Court Decisions Here and There.*"

[23] Remarks of Traffic Court Judge Otis R. Hess of Cincinnati, Ohio, made in Chicago before the National Safety Congress, October 8, 1946.

plus a high fine; and on the second offense a straight jail term is meted out.[24]

Special problems are created by repeaters, juveniles, and psychiatric cases. Repeaters require increased fines and perhaps a jail sentence. Juveniles should be handled in cooperation with the parents. Psychiatric cases will have to be treated the same as the ordinary individual until facilities for a mental examination are made available.

County Judge Robert Troyer of Omaha, Nebraska, is particularly solicitous of creating the proper attitude in the violator. He states:

"No matter what the penalty is, the defendant should know that he is being treated fairly. Of course, there are some defendants whom you could never convince; but with a little patience, most violators will willingly pay the penalty with a smile and thank the judge if they are confident that they were treated as others under similar circumstances.

"I personally believe in the same penalty for a defendant who pleads guilty as one who pleads not guilty except in those instances where additional penalty should be added on for lying. If it is, the defendant should be so informed.

"I will not accept a plea of guilty when the defendant says in effect, 'I did not have any speedometer, but if that is what the officer claims, I guess there is nothing else for me to do except plead guilty.' I explain to defendants that this is a Court and if there is any doubt in their mind, they should plead not guilty and they will be given a full hearing.

"A defendant will often want to qualify his plea, that is, plead guilty 'but.' In these instances, I believe it proper to explain that he must either plead guilty or not guilty, but that he may tell his story in full by way of any mitigation.

"In cases of pleas of guilty, I usually have one of the officers explain briefly the circumstances, ask about the past record of the defendant, then give the defendant his opportunity to say anything that he cares to say. If he is not anxious to talk, I will ask him whether he cares to tell us whether he is married or single, what dependents he has, what his income is, and any other pertinent information. It might be necessary in determining the correct penalty. I invariably ask the prosecutor if he has any recommendations.

"Most important also at the time of the sentence is letting the defendant know the reason for the penalty. In other words, if he had

[24] Remarks of Traffic Court Judge Reva Beck Bosone of Salt Lake City, Utah, made in Chicago before the National Safety Congress, October 8, 1946. Judge Bosone is now a Congresswoman from Utah.

gone through a stop sign, I believe it good practice to allude to a recent fatal accident as a result of a stop sign violation. If he has passed on a hill, you can no doubt allude to a recent head on collision caused by such a violation.

"I feel also that it is most important that the hearing be conducted in a judicial manner. We want the defendant to respect the law. The manner of conducting a hearing can accomplish much towards this aim."

The fines imposed by violation bureaus should be reasonably uniform. Although the bureau is a valuable aid to a busy court, there have been many abuses.

The present difficulties among traffic violations bureaus appear to be as follows: (1) the printed fine schedules in different cities provide widely varying cash fines for identical offenses; (2) most schedules do not provide a sliding scale of fines for repeaters and the ones that do are considerably different; (3) the schedules do not take into account the conditions prevailing at the time and place of the offense; (4) there is too large a gap between the maximum fine for a single serious moving violation and the minimum fine for a reckless driving offense; (5) exceedingly serious traffic violations are covered in violations bureaus which should be covered in court before traffic judges; (6) all violations bureaus are not under the jurisdiction of the court and not operated by them.[25] The violations bureau must aid the court in its effort to secure a high degree of voluntary compliance. Personnel selected to meet the violating public must be courteous, efficient, and imbued with a desire to stress the fact that the violator is participating in the judicial process.

Municipal Judge Marvin J. Salmon of Lansing, Michigan, has declared himself in favor of uniformity and states:

"Naturally the most important function of a judge in hearing a traffic case is to determine the degree of the offense under the attendant circumstances and then to determine whether the motorist is guilty or not guilty and then to determine a fine in keeping with the threat against public safety and in keeping with the person of the violator. All this requires the highest type of judgment.

"At first glance it would appear that each case would thus be completely different from any other case and that there could be no place for uniformity of treatment.

[25] See "Uniform Court Policy for Handling Traffic Cases," an address by Judge Marvin J. Salmon, Lansing Municipal Court, before The Traffic Law Enforcement Division of the Michigan State-Wide Safety Conference, Detroit, September 17, 1946.

"On the other hand judges have always through custom and experience resolved a pattern so that for certain general common types of cases they have a range of fines running from a minimum to a maximum.

"It is suggested that the handling of such cases can have the benefit of some uniformity if judges could agree upon some simple unit evaluation for degrees of violation and degrees of conditions that made the violation more threatening to public safety.

"With such a plan in use motorists would be more apt to feel that they were receiving more consistent treatment by judges and yet each individual judge could still adjust within this uniformity framework to take care of characteristics of the individual violator.

"These matters which I have presented before you today are of basic importance to law enforcement. Uniform printed law with uniform police enforcement policy still cannot provide the public with uniform treatment until the courts likewise can develop a uniform interpretation and application of the law.

"These are matters which no one judge can work out. I am hopeful that the Municipal Judges handling traffic cases in Michigan will form an association. Such a group could quite properly prepare a suggested Uniform Court Policy on traffic cases which when accepted in all cities in Michigan would materially reduce accidents and create a good public reaction toward all law enforcement officials." [26]

All objectives of correcting the violator fail when "ticket-fixing" exists. The Hon. George B. Murphy has reported: "It (ticket-fixing) tended to and did bring discredit to the court and tends to destroy respect for the court and cause loss of judicial dignity which should be inherent in all courts. One of the main purposes of enforcing traffic violations is to teach the public to respect the law and respect the courts, with the ultimate idea in mind of making the streets of Detroit safe for public travel. But, when violators are pampered, as reflected by this practice, they look upon traffic tickets lightly, and are not deterred from violating the traffic laws, because, in the last analysis, to them it means just one more ticket that can be easily "fixed." This all tended to lend disrespect to the court and the enforcement of traffic laws, for which every worthwhile citizen struggled so hard to perfect and paid so many tax dollars in so doing." [27]

[26] *ibid.*

[27] Findings and recommendations of one-man jury "In the matter of Gerald K. O'Brien, Prosecuting Attorney for Wayne County, for a one-man Grand Jury to investigate into the commission of certain crimes in the County of Wayne," Misc. No. 71692, Circuit Court of Wayne County, State of Michigan,

Failure to administer justice fairly and impartially develops a public attitude not favorable to enforcement. It will increase accidents, deaths, and injuries. It makes every participant in such practice a destroyer of faith and confidence in the courts, traditionally the bulwark of freedom.

TRAFFIC COURT STUDY

It is apparent why a thorough investigation of the courts, on a nationwide basis, was undertaken by the National Committee on Traffic Law Enforcement under the following authorization: "The need for modernization of traffic court methods and procedure is emphasized, at the outset, when the somewhat archaic practices still in use in widespread parts of the country are compared with the modern techniques, now gaining such broad adoption, in the fields of traffic control, traffic law enforcement, state motor vehicle administration, modern methods of safety training by educators, highway modernization, police traffic enforcement techniques, and other related fields concerned with the traffic problems. It is imperative that the courts move forward, in concert with all other elements directly involved, in solving both the urban and rural aspects of highway accident prevention. Horse and buggy justice and traffic court procedures developed in coping with the ever increasing problem of dealing with the mass of traffic ordinance and statute violators." [28]

The results of this survey culminated in the publication of the first book to present a complete picture of the conditions prevailing in the nation's traffic courts.[29] Fifty-seven recommendations for improvements were presented and approval secured from the National Conference of Judicial Councils, the American Bar Association, the National Safety Council, and the International Association of Chiefs of Police. These recommendations can be classified under eight titles:

1. Antiquated laws and ordinances must be modernized.
2. Traffic court judges and prosecutors should be properly qualified through education and legal training and should have a special knowledge of traffic safety, engineering and policing.

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made by Hon. George B. Murphy, Circuit Court Judge of Wayne County, Michigan, September 20, 1945.

[28] The National Committee on Traffic Law Enforcement was organized in 1937. Its active chairman was Arthur T. Vanderbilt, then Dean of the New York University Law School and President of the American Bar Association and presently the Chief Justice of the State of New Jersey. See his foreword in George Warren, *Traffic Courts*.

[29] George Warren, *op. cit.*

3. The court should have a dignified atmosphere and adequate physical facilities and should be conducted with such high standards of procedure and decorum as to create a proper respect for the justice administered.

4. Traffic cases should be separated from other court business and separate courts should be created if the volume requires it.

5. The impartial administration of justice in traffic cases requires uniformity in fines and penalties for similar offenses, and uniformity in the sense of certainty and consistency.

6. The fix must be eliminated.

7. The present justice of peace system should be improved, and if it cannot improve must make way for a new system.

8. The primary aim of the traffic court should be to impress defendants with the need for traffic law observance rather than to penalize.

To secure general acceptance of these recommendations the American Bar Association, through its Junior Bar Conference,[30] and the National Safety Council have jointly promoted the National Program for Improving Traffic Courts [31] by furnishing staff assistance and making field visits within the past four years. During that period 221 state, metropolitan, and district traffic court conferences have been held in forty-three states and the District of Columbia.[32] Participation was drawn from judges, prosecutors, police officials, motor vehicle registrars, driver's licensing administrators, city, county, and state officials, bar association leaders, justices of the peace, traffic and safety engineers, and many civic minded citizens. Top leadership was furnished by Governors, Supreme Court Judges, and Attorneys General. During World War II representatives of the Army and the Navy cooperated in the solution of problems confronting the courts with reference to military violators of civilian traffic laws and participated in these conferences. More than 15,000 individuals were contacted by this means.

Beginning in 1947 the Law Schools of Northwestern University, the University of California, Tulane University, and New York University instituted a series of five-day regional Conferences for Traffic

[30] In 1943 the Junior Bar Conference recommended that the Section of Judicial Administration and the Section of Criminal Law participate in the program. The recommendation was accepted and committees of Judges, Justices of the Peace, and Prosecutors are now functioning.

[31] The President's Highway Safety Conference unanimously approved this program. See *Proceedings* (Washington, 1946), 61.

[32] See *Annual Survey of American Laws,* published by New York University, 1943, 8; 1944, 1202. Activity during subsequent years has increased the number to more than 350 conferences in 45 states and the District of Columbia.

Court Judges and Prosecutors. So valuable was the work of these Conferences, at which problems and methods were treated primarily by discussion, that later series were scheduled at each School.

All these activities have furnished a brilliant spotlight on the judicial performance in traffic courts. A stage was provided for frank and open discussion of the current problems encountered by judges and prosecutors presently serving in these courts. Much publicity was given to the program and these meetings.[33]

The immediate result has been to stimulate activity within several states to improve the existing machinery and personnel of the courts. Several states are undertaking a detailed study of their system and comparing it with the 57 recommendations. The outlook for future improvements will continue if consistent attention is devoted to the cause.

Missouri has completely revamped its judicial structure and new magistrates courts began to function in 1947. California's County Court Plan has been studied,[34] and Michigan has worked on a plan for new courts. Iowa, Utah, and Washington are among the other states following suit.

George Warren advocates: "The ideal judicial system of traffic law enforcement would involve the efficient trial of these cases on a uniform basis in a special court before a judge trained for that type of work. The closest approach to this ideal would be by means of a single traffic court for an entire state. This court's authority would be statewide and it would handle violations of both local and state laws. Headed by Chief traffic judge, this court and its procedure would be specifically designed for traffic cases. . . . Modernized along traditional lines of specialization such a court would furnish an efficient, effective and impressive judicial system for the enforcement of traffic laws. A statewide traffic court system would also provide great opportunities for economy. Duplication in a hundred processes would become unnecessary. The number of judges trying traffic cases would be decreased by possibly 90 per cent (if Justices of the Peace are included; possibly 60 per cent otherwise) and the administration of other types of cases would be improved by the removal of traffic offenses which normally crowd them. This type of judicial organization for the trial of traffic cases would bring with it well defined advantages in all seven prerequisites of an excellent minor court system: in (1) good personnel, (2) impartiality,

[33] See *Harper's Magazine* (March, 1946), CXCII, 274; and the *Reader's Digest* (May, 1946), XLVIII, 69.

[34] The Report of the Committee on County Courts is in *Journal of the State Bar of California* (July-August 1946), XXI, 244-262.

(3) availability, (4) speedy procedure, (5) dignity, (6) predictability, and (7) accountability."

Professor Edson R. Sunderland, Professor of Law of the University of Michigan Law School, is not in complete agreement with Mr. Warren. He states his views as follows:

"A separate system of courts for handling traffic violations is, however, impractical. Even in the largest metropolitan centers, where the volume of traffic litigation is the heaviest, it has not appeared feasible to organize exclusive traffic courts, and specialized machinery has gone no further in this direction than the organization in a few cities of special divisions in courts of general criminal jurisdiction to deal with that type of litigation. In non-metropolitan communities even a separate traffic division would usually be out of the question.

"It is obvious, therefore, that as a general rule traffic cases must be dealt with by the same courts which exercise jurisdiction over other minor criminal cases, and their ability to meet whatever special requirements there may be for such litigation.

"Most requirements for satisfactorily dealing with traffic cases are exactly the same as for other types of cases. A competent judge, learned in the law, paid by salary instead of fees, and with enough judicial business to give him adequate experience is needed in any court, irrespective of the nature of its jurisdiction. The same may be said of a competent clerk, a well equipped office, suitable records accurately kept, efficient executive officers, and a convenient and dignified court room." [35]

Regardless of viewpoint, the attack against poor court machinery and unfit personnel must continue unabated. A step in the right direction will be made if the idea of "Schools for Traffic Judges" takes firm root in the judicial acreage.[36] It will provide a training ground which will eventually eliminate dissatisfaction with traffic courts. It can aid in Dean Pound's expressed objectives:

"Unification of courts will not do everything. There must be judges equal to their tasks and unafraid to do them. The mode of selection and tenure must be such as to insure such judges as far as may be. But no judges can achieve results such as are demanded today if they are held to the machinery of the last century. Things are done by the combined working of men and machinery. In the combination

[35] *15th Annual Report of the Judicial Council of Michigan,* Part II, "A Study of Justices of the Peace and Other Minor Courts—Requisites for an Adequate State-Wide Minor Court System," 114, prepared by Edson R. Sunderland, Secretary to the Judicial Council.

[36] *Public Safety* (September, 1946), 7.

machinery is no negligible item. The right men will do much no matter what machinery is given them to work with. But our ideal must be the right men with the right machinery."[37]

Six and one half million traffic violations have flooded the courts with what, to some, appear to be trivial matters.[38] Lest their importance be forgotten you are referred to the Hon. Curtis Bok's philosophy:

"A good judge must have an enormous concern with life, animate and inanimate, and a sense of its tempestuous and untamed streaming. Without such fire in his belly, as Holmes also called it, he will turn into a stuffed shirt the instant a robe is put around him. The first signs of judicial taxidermy are impatience with trivial matters and the statement, that his time is being wasted, for the secret of a judge's work is that ninety-nine percent of it is with trivial matters, and that none of them will shake the cosmos very much. But they are apt to shake the litigants gravely. It is only his power over people that makes them treat him as a demi-god, for government touches them more perceptibly in the courtroom than at any other point in their lives. The cosmos is made up of little quivers, and it is important that they be set in reasonable unison. Show me an impatient judge and I will call him a public nuisance to his face. Let him be quick, if he must be, but not unconcerned, ever. Worse than judicial error is it to mishandle impatiently the small affairs of momentarily helpless people, and judges should be impeached for it."[39]

It is manifestly important that no stone be left unturned to secure the best personnel available with the best court machinery in order to receive dividends from the best possible judicial adjudication of traffic violations.[40] The highway and its operation have revealed a problem which has needed attention for too long a period. May its ultimate solution be productive of more effective use of the motor vehicle upon the highway.

[37] Roscoe Pound, *Organization of Courts,* 293.

[38] See 1949-1950 President's Highway Safety Conference Inventory and Guide for Action, which shows 10,703,933 traffic violations processed in 1948. The number processed through the courts was 3,492,374, the balance having been processed through traffic court violations bureau. These figures were obtained from those submitted by 580 cities over 10,000 population in the second annual Traffic Court Award Contest held in 1948 by the American Bar Association.

[39] See preface in Curtis Bok, *I, Too, Nicodemus* (New York, 1946).

[40] That substantial progress has been made in traffic court improvement is evidenced by the selection of Chief Justice Arthur T. Vanderbilt as the recipient of the 1949 Beecroft Award for his outstanding contribution in improving the administration of justice in traffic courts.

46 SUMMATION

BY JEAN LABATUT

PERHAPS the most important result of this symposium is to bring out the importance of research, as seen from the broad point of view of our national life, in the general problem of proportion between the rapid increase of motor vehicle transportation and the relatively slow development of the motorway system.

The generous contribution of forty-eight specialists, writing short essays most pertinent to their particular fields and the common topic, will not give the answer to the problem, but will point out its complexity, its importance to economic welfare and defense of the nation, and the need for adequate over-all planning.

The lack of sense of proportion between motor vehicle transportation and the motorway, i.e., the lack of proper relation between the content and the container, has brought us where we are today. For example, in this year 1950 we can see somewhere in the United States along a two-lane highway the spectacle of two overloaded 20-ton freight cars trying to pass each other at 50 miles per hour, while an overstreamlined passenger car, with its juke-box-style front only a few yards behind, awaits for an opening. All this taking place with cows grazing along that two-lane highway in a legal open range, and among ugly and inefficient billboards—the relics of an archaic advertising system.

The forty-five themes developed in this symposium may suggest steps toward better over-all planning and toward the development of a better sense of proportions, toward more horse sense brought up to the HP level.

Actually the disproportion between the content and the container is such that the loss of human life on public thoroughfares makes the no-man's land on a battlefield a relatively peaceful environment. As a matter of record, let us quote an announcement dated June 30, 1949. "The National Safety Council estimated today that 290 Americans will die in traffic accidents during the three-day Fourth of July celebration. This carnage, the council said, will be accomplished by 33 million vehicles burning 340 million gallons of gasoline to travel about 4½ billion miles during the holiday. . . . The council said the estimate of traffic deaths was 'made on the basis of past experience' and was not 'a gloomy prediction of inescapable tragedy over the holiday.'" On July 5 the score was 296 deaths.

While the content is made up of over-sized vehicles designed for high speed, the container can be compared to an old leaky waterpipe which has burst and has been hastily repaired with sections of different diameters. However, here and there throughout the country some of the new sections of the motorway system are great achievements. They are obviously but inevitably too rare and too far apart. Some of these new sections, with the high quality of their architecturally landscaped environment, can be classified among the greatest monuments of our time.

But if the multiplication of these new sections cannot be achieved as quickly as needed to form a unified system throughout the nation, it is reasonable to point out that the short-life vehicle allowed to run over them is not designed for the present highway situation, but rather for a motorway system yet to come and of which we have only very small fragments.

Planners and designers of motor vehicles unleash their products (over-blown cars and gigantic trucks and trailers) made for motorways which do not exist. Such an impractical attitude leads to forms of vehicles in which fantasy predominates over safety, simplicity, economy, and beauty.

By contrast, it is comforting to see the work which has been accomplished by the planners and designers of the container, i.e., the motorway, in spite of financial, legal, and technical limitations. The quality of their study as to location of right of way and profiles of the motorway leads to the association and composition of safety and beauty. Perhaps the contrast in quality of the work of the planners and designers of the motorway, and the work of the planners and designers of the motor vehicle, is due to a sense of long-term responsibility provoked by the durability of a right of way compared to the very short life and fragility of a motor vehicle—how hopeless the most powerful and modern car looks with a punctured tire.

In regard to the quality of the achievements of the planners and designers of motorways, it is reassuring to see motorways comparable to a pathway in an old Romantic garden. This is particularly obvious when the two directions of the motorway are not continuously adjacent, are not in a straight line, nor parallel. And if a long straight highway can attract the enemy in time of war, it also attracts accidents in time of peace by taking responsibility from the driver and stimulating speed—facts which have the tendency to make the highway user a brute or a victim. If the long straight line is eliminated in time of peace, the humanization of the road becomes possible and fewer accidents and more beauty are the consequences.

That same road becomes a more difficult landmark and target in time of war. In the design of motorways, a failure to consider the possibility of war indicates a lack of consciousness of the durability of the right of way, which is more permanent than monuments made of granite and more enduring than the longest period of peace. Recent history shows us the consequence of insufficient study in planning motorways, as for example the autobahnen designed for attack rather than for defense.

Long straight highways with adjacent opposing traffic lanes are unhappy souvenirs among highway designers. A two-lane highway has proved to be safer than a three-lane highway when passing in the center is taken as an inalienable right by both sides, thus reducing the drivers' responsibility and increasing the death toll to a point that if wooden crosses marked the site of motor accidents, such roads would resemble a ribbon-development type of necropolis.

In research for proper proportion in motorway design, there is nothing more important than the increase in safety measures without reducing the drivers' own sense of responsibility. It also should be considered that the greater the density of the highway users, the lower is the average quality of human reflex, alertness, and resistance. It cannot be overemphasized that safety in motor vehicle transportation depends on three factors: the above-mentioned human limitations and sense of responsibility, the quality of the vehicle, and the quality of the motorway—which last is one of the most important elements of man's physical environment. Another important problem connected with motorway design is the relation to Population—an answer to a need in turn generating a new desire.

As the fragments of successful motorways increase in number, a consciousness of a new approach in landscape treatment and building design along the motorways will develop. At present, most of the buildings along the highway are located, oriented, and designed, as if the speed limit were that of a galloping horse. Very few studies have been made of architectural compositions along and for the motorway, and designed for actual conditions of speed and visibility.

The 24-hour activity taking place on motorways calls for architectural forms designed for day and night illumination—for a 24-hour architecture harmonizing with the environment of the motorway and not conflicting with safety as is often the case today, when too often the motorway becomes a gigantic and unorganized marketplace.

Today an obvious conflict between safety and economy is the lack of parking and terminal facilities. Stairs cannot be designed without proper landings, a bridge without approaches is useless, but up to

now too many motorways have appeared without sign of adequate terminal facilities. Terminal facilities are an integral part of that composition called motor vehicle transportation, just as means of access and circulation in and around a building are an integral part of an architectural composition. In the long run, financial losses due to the absence of terminal facilities far surpass the cost of establishing them, and it should not be forgotten that inadequate terminal facilities also play their part in the death toll of the nation.

If a certain spirit of romanticism seems to be present in and radiating from elements of motorways or parkways, it is indeed a by-product; a by-product of great importance and with the power of making the large-size mechanism of a motorway more human. Motorways will be great memorials and monuments of our time as were the old Persian highroads described by Ctesias and quoted in the essay by Ernst Herzfeld: "Semiramis built a highway from Babylon to Agbatana [Hamadan], levelling the eminences and filling the depressions, in order to leave an immortal monument."

In the same essay, Isaiah is quoted as saying:

> In the desert clear the way for YHWH,
> make straight a high road for your God in the 'Arābhāh
> Every valley shall be raised
> and every mountain and hill made low;
> the crooked shall become straight
> and the *rᵉkhāsīm* a plain!

Isaiah seemed to qualify as the patron of the bulldozer drivers; but whatever Isaiah would have done with a bulldozer, we should not let a wild bulldozer drive its driver, we should not let every valley be raised, every mountain and hill made low, all curves made straight. We should make the motorway safe, as safe as humanly possible.

The motorway is an integral part of the physical, intellectual, and emotional human trail. New eras—new opportunities; new means—new forms. If the footprint of our era expresses the triumph of courage, honesty, and truth over timidity, ignorance, and fraud, it will be a sign toward a better future.

JEAN LABATUT
Chairman, Executive Committee
Bureau of Urban Research

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J. L. HARRISON has long been interested in the Pan American Highway, having been principal highway engineer, Inter-American Regional Office, of the Public Roads Administration, now the Bureau of Public Roads.

The late Dr. ERNST HERZFELD was one of the world's leading authorities on the ancient Near East. For fifteen years a professor at the University of Berlin, he conducted extensive explorations and excavations in the region between Syria and Afghanistan. His later career was passed at the Institute for Advanced Study at Princeton, where he retired as professor emeritus. His scholarly output was enormous, two of his last works being *Iran in the Ancient East* and *Zoroaster and His World.*

L. I. HEWES is chief of the western headquarters, Bureau of Public Roads. He has been associated with that organization in various capacities since 1911. He is the author of several books, the latest being the two-volume *Highway Practice*. In 1946-1947 he served as highway engineering consultant for the government of Saudi Arabia.

SAMUEL G. HIBBEN is director of applied lighting of Westinghouse Electric's lamp division at Bloomfield, New Jersey. One of the nation's foremost illuminating engineers, he helped develop the first system of transcontinental airway beacons and the first modern floodlighting for public monuments. In World War I he served with an Army searchlight and sound-ranging battalion in France, and more recently he was an adviser on blackouts to defense committees in the eastern states. He is currently active in studies of military illuminants. He is a fellow of the Illuminating Engineering Society and is closely affiliated with many other national electrical and engineering associations.

HOMER HOYT is urban real estate consultant of Homer Hoyt Associates. He was formerly lecturer in urban land economics at the Massachusetts Institute of Technology and at Columbia University. He has also been principal housing economist of the Federal Housing Administration; director of research, Chicago Plan Commission; and director of economic studies, Regional Plan Association of New York. He is the author of two books on land values and the growth of cities.

SIGVALD JOHANNESSON has recently retired from his position as director of the division of planning and economics, New Jersey State Highway Department. As a civil engineer, he engaged in tunnel construction in England in his early career. Later, in this country, he played an important part in the design of the Pennsylvania Railroad tunnels under the Hudson, and in the reconstruction of the elevated railways of the Interborough Rapid Transit Company. In New Jersey, he was in charge of design of the famed Pulaski Skyway.

G. DONALD KENNEDY is consulting engineer and assistant to the president of the Portland Cement Association. He was formerly vice-president of the Automotive Safety Foundation. Prior to joining the Foundation at the time of its organization, he was state highway commissioner of Michigan. He has served as president of the American Association of State Highway Officials. He acted as vice-chairman of the National Committee on Inter-regional Highways, whose 1944 report became the basis for the National System of Interstate Highways now being developed. Mr. Kennedy has also made noteworthy reports on highways to the United States Senate and the United States Chamber of Commerce.

ORIN L. KIPP is assistant commissioner of highways and chief engineer, Minnesota Department of Highways, with which he has been associated since 1917. His services as administrator and active committee member have been many. He has been a member of the committee on road design of the American Association of State Highway Officials; a member of the special committee on administrative design policies of that same organization; and a member of three important committees of the Highway Re-

search Board; also secretary of the Mississippi Valley Conference of State Highway Departments.

FRANKLIN M. KREML is director of the Traffic Institute, Northwestern University; and director of the traffic division of the International Association of Chiefs of Police. As a law student he became interested in police work in accident prevention, and he subsequently organized an accident-prevention bureau in the Evanston Police Department, the first of its kind in the country. The Traffic Institute has trained over 1,300 police officers from all sections of the United States, while the I.A.C.P. Traffic Division has assisted in reorganizing accident-prevention functions of city and state police departments throughout the nation. His record in World War II was outstanding; he won many awards for his efficient staff work in transportation in both North Africa and Italy.

JEAN LABATUT, architect, A.I.A., S.C.A.F., registered in the State of New Jersey and in France, is professor of architecture and chairman of the executive committee of the Bureau of Urban Research at Princeton University.

WHEATON J. LANE is an historian living in Princeton, New Jersey. His books include *Commodore Vanderbilt* and *From Indian Trail to Iron Horse.*

CHARLES S. LECRAW, JR., is resident traffic engineer, Eno Foundation for Highway Traffic Control. Receiving his early training from the Yale University Bureau of Highway Traffic, he later became associate editor of *Traffic Engineering*. During World War II he served in the Army as a lieutenant colonel, holding various traffic and transportation posts. He is the author of several books and articles on traffic control.

DAVID R. LEVIN is chief of the land studies section, Financial and Administrative Research Branch, Bureau of Public Roads. He earlier headed the special administrative studies unit in that same branch in the former Public Roads Administration. He has been chairman of the committee on land acquisition and control of highway access and adjacent areas of the Highway Research Board; and secretary of the committee on right of way of the American Association of State Highway Officials. He has written extensively on the legal and administrative aspects of land acquisition, highway access, and roadside development.

SAMUEL O. LINZELL is director, Department of Public Works, State of Ohio. He had earlier held the position of assistant research engineer with the Ohio Department of Highways. In World War I he served overseas with the Canadian Army; and more recently, he was employed by the Corps of Engineers to supervise maintenance of roads, runways, and railroads in the Fifth Service Command Area.

Charles P. Loomis is head of the department of sociology and anthropology at Michigan State College. His earlier academic career included posts at North Carolina State College and Harvard University. He is the editor of the *Journal of Rural Sociology,* the author of *Fundamental Concepts of Sociology* and *Studies in Rural Social Organization,* and has contributed numerous articles to learned journals in his field.

Alvan S. Mathers, of the firm of Mathers & Haldenby, has been a leading architect in Toronto since 1919. He is a past member and onetime chairman of the advisory technical committee of the Toronto City Planning Board, and is a member of the planning committee of the Toronto Board of Trade and of the national capital planning committee of the Federal District Commission. His firm has been responsible for many important buildings, including four at the University of Toronto. He is an academician of the Royal Canadian Academy of Arts, a fellow of the Royal Architectural Institute of Canada, and a fellow of the Royal Society of Arts.

Francis E. Merrill is professor of sociology at Dartmouth College. He received his graduate training in sociology at the University of Chicago. He is the author or co-author of seven books, of which the two latest are *Social Problems on the Home Front* and *Courtship and Marriage.*

Harry D. Metcalf is chief of the division of motor transport, of the Ohio Department of Highways. In World War I he served overseas as a lieutenant of engineers; and upon his return he entered the Franklin County Engineer's office at Columbus, later becoming connected with the Ohio Department of Highways as resident engineer.

D. Grant Mickle is director of the traffic engineering division of the Automotive Safety Foundation. His earlier career had been spent in Michigan where he was traffic engineer of the City of Detroit, and traffic and safety engineer of the Michigan State Highway Department.

Spencer Miller, Jr., has been New Jersey State highway commissioner since 1942. He has been the official and effective leader in the movement for a comprehensive system of parkways and freeways and for roadside improvement. Under his leadership the state has evolved a five-year plan for their realization. In the recent war he performed various important duties, such as acting as federal representative in the construction of military access and strategic road networks, fifty-two being completed under his direction. Mr. Miller served as a delegate from New Jersey on the President's Conference on Highway Safety and as a member of the Governor's Committee on Highway Safety.

Harold J. Neale has been landscape engineer of the Virginia Department of Highways since 1930. He was previously city forester and superintendent of parks in Worcester, Massachusetts; and then for ten years land-

scape architect and general superintendent of the Audubon Park Commission at New Orleans. Since 1932 he has been chairman of the committee on roadside development of the Highway Research Board.

Julius H. Parmelee is vice-president of the Association of American Railroads. A graduate of Yale where he also received his post-graduate training, he was for two years a special examiner for the Interstate Commerce Commission. He entered the Bureau of Railway Economics as a statistician in 1911, becoming its director in 1920, a post which he still holds. Mr. Parmelee is the author of numerous articles on railroads and of two books, of which the latest is *The Modern Railway.*

Shorey Peterson is professor of economics at the University of Michigan. With minor interruptions he has been active in the department of economics since 1921, with his main interest lying in the broad field of government and business. Professor Peterson has served in Washington with the National Defense Advisory Commission and the National Resources Planning Board. He has also been a member of two committees of the Highway Research Board that were concerned with economic aspects of highways.

George Romney is now vice-president of the Nash-Kelvinator Corporation. Formerly general manager of the Automobile Manufacturers Association, he has since 1939 been closely identified with the automobile industry. In the recent war he served as managing director of the Automotive Council for War Production, as vice-president and director of the Detroit Victory Council, and as a management member of the War Manpower Commission in the Detroit area.

Albert C. Rose is chief of the Visual Education Branch of the Bureau of Public Roads, a position he has held since 1924. He started his early career as an engineer with the Washington State Highway Department, and subsequently became associated with the district office at Portland of the Bureau of Public Roads. He has done outstanding work in the preparation of exhibits, motion pictures, models, diaramas, etc., for road congresses and expositions.

Charles Ross is general counsel for the Carolina Road Builders Association, serving North and South Carolina. For twenty years he was general counsel of the North Carolina Highway and Public Works Commission; and for fifteen he was chairman of the committee on legal affairs of the American Association of State Highway Officials. He is the author of *Highway Laws and Practices in North Carolina,* and has contributed frequently to symposia and learned journals.

Herbert J. Spinden is curator of the department of primitive and New World Cultures, of The Brooklyn Museum. He was earlier affiliated with

the Peabody Museum, the American Museum of Natural History, and the Buffalo Museum of Arts and Sciences. Dr. Spinden has conducted many field expeditions in Central America, and solved the chronology of Mayan inscriptions. He has lectured extensively at universities in both North and South America, and is the author of many books and articles on Indian anthropology.

Sir Alker Tripp, C.B.E., has been assistant commissioner of police, New Scotland Yard, London, since 1932. He was appointed a staff officer at that famous institution in 1902, and came to specialize in traffic problems. He is the author of *Road Traffic and its Control,* and *Town Planning and Road Traffic.*

Leslie Williams is a consultant in city planning, traffic, and transportation. Educated at Harvard with special training in city planning, he later taught at Yale, and was appointed executive director of the Civic Planning and Traffic Board of Providence. In 1944 he became city planning and traffic engineer with the American Transit Association in New York City. He has been a consultant to many large American cities, and has lectured extensively in American universities. A past editor of *Traffic Engineering,* he has contributed many articles on city planning, transit expressways, parking, and zoning.

Hans F. Winterkorn is a member of the department of civil engineering at Princeton University. Educated at Heidelberg and Massachusetts Institute of Technology, he has frequently been a consultant in soil mechanics to such organizations as the Missouri State Highway Department, the Direccion Nacional de Vialidad of Argentina, the Civil Aeronautics Administration, the U. S. Engineers, and the Bureau of Yards and Docks.

Carle C. Zimmerman is a member of the department of social relations at Harvard University. He has had unusual experience in various fields, and is a veteran of both World Wars. He acted as economic adviser in rural affairs to the Siamese Government, 1930-31, and served on the Cuban Commission in 1934, after the Revolution of 1932-33. He also served on the Canadian Pioneer Belt Commission. He is the author of half a dozen books, including *Family and Civilization.*

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